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A Feasibility Study of the Influence of Capital Expenditures on Hospital Operating Costs

Department of Health, Education & Welfare • Health Care Financing Administration

A FEASIBILITY STUDY OF THE INFLUENCE OF CAPITAL EXPENDITURES ON HOSPITAL OPERATING COSTS

FINAL REPORT

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PURPOSE AND METHODOLOGY

Background and Purpose of Study

With health care costs expanding from six to nearly nine percent of the GNP in the decade, public policy makers must critically evaluate the opportunity costs of these expenditures and their effects on other social objectives. Within the health care system, the hospital sector gives the most cause for concern. Between 1972 and 1977, for example, personal expenditures for hospital care rose an average of 15.1 percent per annum.[1/]

While the underlying factors which give rise to the persistent and significant increases in health care costs are not well understood, some recent studies in the hospital sector, at least, have suggested that "service enhancing" effects are more important than "price" effects in explaining hospital cost inflation. For example, the American Hospital Association (AHA) recently released a study which suggests that annual hospital per diem cost inflation between 1969 and 1974 would have been about 7.4 percent, assuming no increase in the "intensity" of services provided per patient day, in comparison to the 13.4 percent overall annual inflation rate.[2/] Intensity of

1/ Social Security Bulletin, April 1977.

2/ P. Phillick, J. Jeffers and A. Hai, "Indexes of Factor Input Price, Service Intensity, and Productivity for the Hospital Industry," in The Nature of Hospital Cost: Three Studies (Chicago, Illinois: Hospital Research and Educational Trust), 1976.

services in this context could be interpreted to mean provision of the same services spread over fewer patient days (which has undoubtedly occurred in some instances with decreasing average lengths of stay) as well as improvements in the quality of care and access to care with the introduction of more beds and technologically improved services in more locations. While such analyses may provide the hospital industry some relief from accusations of being inefficient, it does not reduce the financial burden on purchasers of hospital services. In fact, the AHA study only serves to highlight the need to define the share of the GNP society desires to devote to health care and the need for some control over the factors producing cost increases (if indeed the desired share of the GNP is less than that which would occur in the absence of such control, as is commonly presumed today).

It has been suggested that the trend toward service enhancement in the hospital sector has produced market allocation inefficiency. This misallocation can take the form of: (1) excess investment in facilities and services (e.g., beds, CAT scanners), (2) excess utilization of services which are quality enhancing (e.g., laboratory tests, CAT scans), and (3) excess utilization of acute care services in relation to lower cost alternatives.[1/] The three factors are related in that the current stock of capital assets and the rate of growth in capital investment set the upper bounds on the volume of services that will be available in the future.

But the obvious question is who is to define excess investment? Ideally, the definition would come from the market place; consumers individually and collectively deciding what quantity and quality of services they are willing to pay for. However, cost-based insurance has largely removed immediate cost considerations from patient

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[1/] It must also be recognized that elements of these issues have implications with regard to technical efficiency (the use of the most productive techniques) and economic efficiency (use of the best mix of production inputs), as well as market efficiency.

decisions regarding institutional care, and further, by the very nature of health care, consumers do, and in large part must, delegate relatively more decision-making authority regarding their treatment to physicians than they normally delegate to providers of other services or products. Investment decisions, and hence availability and quality of institutional service decisions, have thus traditionally fallen on the shoulders of providers.

The high rate of increase in hospital costs, caused in part by secure reimbursement for both capital expenditures and operating costs, has led to the trend of the last decade toward regulation. The first and perhaps primary form of regulation is capital expenditure and services (CES) control. Since 1965, numerous State certificate-of-need programs have been implemented, and a similar program is required of all States by Section 1122 of the 1972 Social Security Amendments. As of this year, all States with the exception of Missouri have some form of CES control. Further, the National Health Planning and Resources Development Act of 1974 and associated regulations require all States to review and approve all capital expenditures which exceed $150,000, increase or decrease a facility's beds by an established amount, or add a health service.

The effectiveness of CES control has been a question of concern to public policy makers. On the one hand, a very large percentage of proposals have generally been approved, but on the other hand, it has been maintained that planning agencies successfully discourage hospitals from proposing unneeded capital expenditures and that the "market research" of hospitals has improved significantly. Nevertheless, the need for cost containment has not abated, despite the efforts of CES programs (as well as rate regulation and utilization review programs), and the need for some type of absolute limit on capital expenditures is seen in some quarters. Although the recent proposal for cost containment legislation at the Federal level, the Hospital Cost Containment Act of 1977, contains a provision for capital expenditure limitations, the final form of such limits, if any, is obviously yet to be determined.

The Administration's proposal calls for a $2.5 billion national ceiling on capital expenditures of over $150,000, and general standards of no more than 4.0 beds per 1,000 population and at least 80 percent aggregate bed occupancy would be established for each of the nation's 212 health service areas.

Capital expenditures obviously have a significant impact on downstream operating costs. As mentioned earlier, the operating costs resulting from a capital expenditure (at least one that adds service capacity or a new service) are a function of both utilization and production costs. The causal relationship between capital and operating costs prompted the provision for limitation of capital expenditures directly in the Administration's bill, rather than relying solely on its other regulatory provision, a limitation on increases in gross revenue. If the ultimate goal is to control revenue and/or operating expenses at the national level, then the impact of various types and levels of capital expenditures on operating costs must be understood.

Planning agencies are also in need of information regarding the operating costs associated with capital expenditures. First of all, planning agencies are charged with assessing the reasonableness of operating cost projections as part of their review of proposed capital expenditures, and they currently have no systematic source of data broken down by medical service to use for comparative purposes. Further, planning agencies are not to review proposed capital expenditures on the merits of each individual proposal, but rather to review each proposal within the context of a comprehensive health systems plan. They are also to take positive as well as reactive steps to encourage capital development needed to implement the plan. In developing a long-term plan as well as short-term implementation plans, decisions should be made with a goal in mind for the optimal rate of increase in health care costs and also hospital costs as one component of the health care system.

Planning agencies are presently ill-equipped to carry out this type of planning. Among other things, they need to develop data resources to measure current operating expenditures for hospital care and to assess the impact of proposed changes in the health system on operating costs.

It should be noted that rate regulators must also analyze the effect of capital expenditures on operating costs. In approving a prospective operating budget as the step prior to promulgation of reimbursement rates, such agencies must predict and, in fact, assess the reasonableness of operating costs emanating from changes in services and facilities made since the last rate approval decision.

Finally, hospitals obviously must forecast operating costs as well as patient volume and revenue as part of their own planning process when contemplating capital improvements, and also to meet the reporting requirements of planning agencies and rate review agencies.

The purposes of this study can be summarized as to:

- develop a methodology for measuring the influence of selected capital expenditures on hospital operating costs;
- test and refine the methodology on five different patient care services at one hospital each;
- compare and contrast the impact capital expenditures have on operating costs for the five types of services;
- assess the methodology in the context of different and expanded methodologies that might be developed to address the general issue; and
- assess the generalizability and potential use of the methodology and data produced from the methodology by the users discussed above.

Because all of the potential users (i.e. federal researchers and policy makers, planning agencies, rate review agencies, and hospitals) could not be questioned regarding use of the methodology and type of data developed in the study, the assessment of the utility of the study results must be considered quite preliminary.

Further, because the methodology does not address all aspects of the capital/operating cost relationship, and because only a limited number of services and hospitals could be analyzed within the resources available, the project must be considered to be a feasibility study. The results of the study are intended to aid the Health Care Financing Administration in charting a course for future research efforts.

Conceptual Approach

There are a variety of cost concepts which are to be used in this analysis. The most important of these is the concept of incremental cost. Economists have traditionally used the concept of marginal cost in the theory of production. Marginal cost is the change in total production cost associated with the production of one more unit of output. In cost-benefit or cost-effectiveness analysis, however, the researcher is seldom able to measure discrete, one unit changes in output. Rather, the investment or option being considered usually involves a change of several output units in magnitude. In the present case, the introduction of a new hospital service with a capacity for multiple units of output is the investment or option under consideration. In these circumstances, the additional cost associated with the addition of such a service is defined as incremental cost.

It is important to keep the distinction between the two concepts - incremental cost and marginal cost - clearly in mind. Incremental cost is a measure of the change in cost associated with the introduction of a new service unit to the hospital measured at a given capacity utilization level for that service unit. The marginal cost remains unknown, however, because measurements are not taken as the output of the service unit changes in one output unit steps. Marginal cost cannot be deduced from the incremental cost either. Incremental cost represents the measurement of a single point on the cost-output continuum and a single point does

not determine a line. That is, marginal cost varies through the output range denoted in the measurement of the incremental cost. Moreover, marginal cost in all likelihood does not vary linearly within this range so that dividing incremental cost by the number of output units associated with the incremental cost is a very poor approximation of marginal cost.

In the present case, the incremental costs are expressed on a per unit basis for ease of interpretation, but this "average incremental cost" is not marginal cost. In fact, the use of average incremental cost can be misleading when evaluating the production of multiple service units of the same service type and the service units have varying output capacities and/or are operating at different output levels. In the present case, this is a moot point, since only one unit of each service type is being examined.

Not only are varying cost concepts involved in this analysis, but the measurement of these costs will vary depending upon the intent of the analysis. The most straightforward measurement is that of social cost (in the present case, social incremental cost). Social cost represents the cost to society of the activity under consideration, or, in other words, the measurement of the value of all the resources devoted to this activity. Note that it makes no difference where, or upon whom, the burden of these costs lie. It does not matter how the costs are reflected in the accounts of a firm, which cost-center, or which firm. The key is to measure the value of all resources so identified at their highest valued use (traditionally, the market value).

Of course, national policy issues or questions of interest to society as a whole should be decided upon and measurements taken from this point of view. By the same token, however, many issues must be settled on the basis of measurements taken from an individual's point of view, a firm's point of view, or a local area point of view. In these cases, not all of the resources need be included in the

analysis. Only those resources whose cost represents a burden to the point of view being taken are to be considered for measurement. The resulting cost figures are the private costs (for this analysis, private incremental cost). An individual student makes his choices as to his continual participation in school on the basis of his foregone earnings and out-of-pocket costs even though the full cost of his education may be heavily subsidized by the State. A hospital administrator is interested only in the budgetary changes necessitated by a given action even though substantial resource levels impacted by the action do not appear in the budget.

In conducting this study, there were three types of situations where social incremental costs and private incremental costs were apt to be different. The first is where part of the necessary physical plant already existed. That is, a structure was available to house the new service unit either partially or in whole. As such, the cost of this physical plant was already reflected in the budget, and to the extent that it was, its cost need not be attributed to the addition of the new service from the point of view of the hospital administrator. Thus the private incremental cost of adding the new service is less than the social incremental cost of doing so. That is, even though the value of the existing physical plant is not reflected in the private incremental cost of the new service by virtue of its previous presence in the budget, it is nevertheless included in the social incremental cost, because it is a resource being devoted to the new service unit. Its previous status relative to the budget is immaterial.

By the same token, a second situation is where other resources (primarily labor) which were already reflected in the hospital budget were shifted to the new service without replacement. In this instance, no budgetary change would result so that the shift in resources would not be included in the private incremental cost. The value of these resources would be included in the social incremental cost because of their use in the new service unit regardless of their previous budgetary status.

While the first two situations imply that private incremental costs will be lower than social incremental costs, the third situation does not so imply. When the new service avails itself of the output of existing service units (a new burn care unit may require lab tests from an existing laboratory), the presence of factor indivisibility may cause private and social incremental costs to be unequal. It is only possible up to a limited extent to hire or buy resources in fractional shares (e.g., part time employees, slightly lower capacity equipment). Therefore, at any given service unit capacity utilization level, it is likely that some resources will be slightly below a full output level whereas others may be producing at slightly above their normal or rated capacity (i.e., overworked).

Thus, it is possible that a few additional lab tests may be produced each time period without any increase in inputs (except those used in strict proportion). In this case, private incremental cost is lower than the social incremental cost. It is also possible that a requirement for just a few more x-rays per time period will necessitate the purchase of an additional or a larger piece of equipment because of the existing full or overutilization of the previous equipment. In this case, the private incremental cost would be greater than the social incremental cost.

In this third situation, a problem is encountered in measuring the costs of the production of the additional output units from existing service departments. From the private incremental cost viewpoint, these additional units can be treated <u>at the margin</u> so that the full change in departmental cost can be attributed to them. That is, where existing resources can be stretched the private cost would be close to zero, and, where the additional units required a discrete addition to labor or equipment, the private cost for these units would be disproportionately high. Note that this measurement approaches the concept of marginal cost, particularly where the number of output units being considered is small.

From the viewpoint of social incremental costs, however, one cannot assign a hierarchical claim to the input resources on the part of any particular output set. That is, all outputs have equal claim to the inputs necessary to their production, at least to the extent that the outputs are homogenous. Therefore, it is more appropriate that the value of each of the outputs be determined on the basis of average production costs in the service unit, rather than marginal costs.

Clearly, then, a choice must be made in the present analysis as to whether to measure incremental costs from a private or a social point of view. The choice was made for social incremental costs for two basic reasons. First, social incremental costs will be more generalizable; that is, less variance in cost for departments producing the same type and quantity of service. The social incremental cost is a function of a department's costs of production for a given volume, and, while there are obviously differences from hospital to hospital, it would be expected that similar hospitals (in terms of such factors as size and scope of services) would have similar costs of production. Private incremental costs are not only a function of production costs, but also a function of the existing situation at each hospital: whether there is existing excess capacity, whether factor indivisibilities will be encountered, etc. Further, to the extent the measured costs for each type of service studied are generalizable, then a comparison of the ratio of operating to capital costs among services using a small sample size as per this study will be valid.

The second reason for selecting the social incremental cost concept is that significant methodological problems are associated with measuring private incremental costs. In going from one time period to the next, a change in the output of a department may be attributable to a number of factors other than the introduction of a new hospital service which produces a demand for that output.

Other capital expenditures may have been made during the period which place demands on a given department's services, and volume of patients drawing upon a department's services may increase or decrease substantially independent of any capital expenditure (i.e., due to such factors as population change, new physicians on staff, changing treatment philosophies, etc.) Further, a department may incur costs for the dual purposes of meeting new demand and upgrading the quality of service to all users of its services (e.g., automated laboratory equipment which expands output capacity but also gives more accurate results and quicker turnaround). Retroactive isolation of the cost impact of only one factor producing demand in a dynamic environment would be extremely difficult.

Finally, as a practical matter, the magnitude of the difference between the social incremental cost being measured and the private incremental cost as viewed from the hospital administrator point of view is probably limited in most instances and can be adjusted for in many other instances. First, however, a further clarification of terms is needed. The costs of operating a particular hospital service (department and/or cost center) are comprised of direct (or primary) and indirect (or secondary) costs. Direct costs are those incurred within the department of interest, and indirect costs are those incurred in other departments of the hospital for the purpose of supporting the department of interest.

The divergence of private and social incremental costs in terms of the direct cost elements pertains to only the first two of the three situations or possibilities described above. In the case of a new service using existing and presumably unused plant, the difference between the two concepts is easily recognized and measured. Slightly more difficult to reconcile is the shifting or diversion of resources within the hospital without replacement. Fortunately, the occurrence of such resource shifting without replacement can be expected to be uncommon, unless the capital expenditure under study was added to an existing department.

The measurement of social incremental indirect cost is likely to result in a figure that is very large (often a multiple of the direct costs). At the same time, the measurement of private incremental indirect cost is likely to be very small, because the impact of the new department is spread over numerous other autonomous departments or even semi-autonomous sections of a department (e.g., the chemistry, hematology and blood bank sections of the laboratory). Because the additional volume of output required within each department or section is often small in comparison to its total output, the existing resources may be able to handle the increased volume with few significant changes. Thus in order to convert social incremental cost into private incremental cost, one important step would be to by-and-large ignore or subtract the indirect cost measurements.

There are, of course, exceptions to this premise and considerable care must be exercised to identify these exceptions. For instance, a new/expanded inpatient or outpatient service may create the need for significant expansion within such support services as the heating and cooling plant, dietary, surgical suite, laboratory, and diagnostic radiology. Or, the administrative duties related to the new service may be added to the responsibility of existing managerial level personnel (e.g., the chief technician or administrative assistant in diagnostic radiology taking over managerial responsiblity for a new radiation therapy department in addition to his former duties).

Selection of Study Services and Hospitals

As mentioned previously, the study was limited to five types of services and one hospital per service. It was decided to limit the study to introduction of new services or beds (i.e. excluding renovation intended solely to modernize facilities or update equipment), and to include both addition of beds and investment in high-technology ancillary services. In selecting specific services, an attempt was made to identify those services for which the prognosis for continued growth was favorable, and those which might be implemented in a fairly wide range of types and sizes of hospitals.

Hospitals were selected which had made the capital expenditures of interest, either through renovation of existing space or construction, between 1971 and 1974. Operating costs were then measured for fiscal year 1977. A lag period between introduction of the services and the period of operating cost measurement was thought appropriate in order to avoid the effects of "start-up" costs. Comparability and data collection problems were avoided by limiting selection of hospitals to non-profit, non-governmental, and non-university institutions.

The hospitals which agreed to participate in the study and the services applicable to each are as follows:

Crozer-Chester Medical Center
Chester, Pennsylvania

- Burn Treatment Center
- Inpatient Psychiatric Unit

Westmoreland Hospital
Greensburg, Pennsylvania

- Linear Accelerator
- Medical/Surgical Units

Sutter Community Hospitals
Sacramento, California

- Renal Dialysis Units (Standard and Limited Care)

Methodology

In terms of process, a literature review was performed for each of the five services, and customized data collection guides were developed for each service. A two-person team visited each study hospital, spending one to one and a half days on-site for each service. Interviews were conducted with the study department's physician director (if applicable), department head, and other personnel in the department, as well as with the administrator and controller of the hospital. Data such as the Medicare Cost Report, internal accounting data, volume statistics, personhours, and salary schedules were collected in both the study department and the accounting office. After a draft of the five case studies had been completed, a conference was held involving the administrators of the participating hospitals, the project staff, the government project

officer and other interested government officials to discuss the results of the study and the ramifications of it for future policy and research efforts.

The methodology employed for analysis is explicated below, broken down by measurement of capital expenditures, direct operating costs, and indirect operating costs. Significant methodological problems encountered are noted as applicable.

(a) Measurement of Capital Expenditures

The capital expenditures were broken down into building, fixed equipment, and movable equipment categories, in accordance with common practice in hospitals. There was evidence of non-comparability in classification of costs into the three categories by the study hospitals, but it was not considered cost-effective to develop and apply a uniform taxonomy of such expenditures. All costs capitalized by the hospital were included (i.e. such items as architect's fees, equipment shipment costs, etc., in addition to expenditures for the assets themselves).

One important methodological issue to be dealt with was the measurement of capital costs for a structure that was built as part of a larger construction project. Generally, costs can be divided by the square footage of the respective sections of the building, but in some cases this would significantly bias the measurement. One such example is the thick protective concrete and high ceilings needed to house the linear accelerator studied, which produced a considerably higher cost per square foot than the outpatient clinic built as part of the same project. This and other such cases were handled by obtaining an estimated allocation of construction costs from the hospital's plant manager, who in turn often relied upon construction contractor estimates.

A second issue requiring a change in the data originally supplied was a case where a portion of the space originally built and equipment purchased were not used during the period of analysis due

to a change in treatment philosophy. An item-by-item review of the capital expenditures was necessary in order to estimate the costs to be excluded. The inverse situation would also be expected to occur occasionally; that is, later addition of equipment and/or space in order to produce the volume or type of services to which the measured operating costs relate.

In order to produce comparable ratios of operating to capital costs for the various services studied, it was necessary to adjust for the fact that the capital expenditures were made in different years. All capital expenditures were projected to 1977 dollars (the year in which operating cost data were collected) using two indices.

Of the 19 construction cost indices published by the U.S. Department of Commerce, the one believed to be most applicable to hospital construction and fixed equipment costs is the Boeckh Index of Construction Costs for Apartments, Hotels, and Office Buildings developed by the American Appraisal Company, Inc. An index specific to the health care industry has not been developed. The Boeckh Index is a simple average of indexes for apartments, hotels, and office buildings constructed with: (1) brick and wood, (2) brick and concrete, and (3) brick and steel. The national index is based on data from 20 major pricing areas. Taken into account are prices for building materials (brick, common lumber, portland cement, structural steel, heating and plumbing equipment, glass, hardware, and paint), common and skilled labor wage rates, and sales and social security payroll taxes. The index is also adjusted to reflect the effect of labor shortages and labor efficiency, as determined by monthly studies in each of the 20 pricing areas.

The Department of Commerce also publishes numerous indices for components of the Standard Industrial Classification (SIC). In the two major groupings encompassing equipment, only one of 92 subcomponents relates specifically to the health field. This is "Radiographic and Electromedical Apparatus," and the grouping includes items such as electrocardiographs, electroencephalographs,

electromyographs, fluoroscopes, diagnostic x-ray apparatus, therapeutic x-ray apparatus, and radium equipment. While specifically applicable to only one of the service areas under study, the index associated with this grouping was used to project movable equipment expenditures simply because it was the best tool available. However, the index was constructed only through 1975, and it was therefore necessary to project values for a period of two years. This was accomplished with a least squares regression utilizing the CPI as the independent variable. A very strong .98 correlation between the two indices over the period of 1967 to 1975 was found, such that the projection can be considered quite accurate barring any unusual price developments during the 1975 to 1977 period. The index values for the Boeckh, Radiographic and Electromedical Apparatus, and Consumer Price Indices over a ten-year period are listed in Figure 1.

A fourth issue requiring adjustment of the capital expenditures data was the non-comparability of capital expenditures for renovation of existing space rather than full construction. Two of the five services studied, the Burn Treatment Center and the Renal Dialysis Units (Standard and Limited Care), were the product of renovations. The actual expenditures for both fixed and movable equipment were utilized, but the cost of the structures housing the two services was imputed utilizing data available in the second edition (1977) of the Dodge Research Report on Hospital/Healthcare Building Costs published by the McGraw-Hill Information Systems Company. The Dodge Report provides statistical and descriptive abstracts of construction projects completed in 1975 and 1976.

Abstracts selected for comparison were limited to additions to existing facilities for single specialty units. The available data show significantly lower costs per square foot for additions in contrast to the construction of entire hospitals, and significantly higher costs per square foot for addition of specialty units in contrast to medical-surgical units. Abstracts noting unusual cost factors (inclusion of costs related to future expansion, extensive

Year	Boeckh Index of Construction Costs for Apartments, Hotels, and Office Buildings	SIC Index of Radiographic and Electromedical Apparatus	Consumer Price Index
1967	100.0	100.0	100.0
1967	107.0	105.3	104.2
1969	116.4	113.1	109.8
1970	124.4	120.7	116.3
1971	134.9	128.3	121.3
1972	145.3	132.4	125.3
1973	153.9	129.8	133.1
1974	168.3	143.5	147.7
1975	184.9	167.6	161.2
1976	199.6	172.8[1/]	170.5
1977	214.8	183.7[1/]	181.5

[1/] Projected based on relationship to CPI.

FIGURE 1 : INDEX VALUES FOR THE BOECKH, RADIOGRAPHIC AND ELECTROMEDICAL APPARATUS, AND CONSUMER PRICE INDICES OVER TEN YEAR PERIOD

sitework, etc.) were also excluded. Two projects met these criteria, and the imputation for both burn care and renal dialysis was based on the average of the costs per square foot of these projects. The costs were then projected to 1977 dollars, using the previously cited construction cost index, and adjusted for differences in construction costs by geographic area, using data provided in the Dodge Report which compares relative costs in 183 cities across the country for the period of 1972 to 1977.

In measuring operating costs, depreciation was included as an expense item to reflect the "rental cost" associated with utilizing the facilities and equipment. Depreciation for the study services was imputed from 1977 dollar capital expenditures, again to improve the comparability of data among the study services. The study hospitals' depreciation data for all other departments (i.e., indirect costs) were necessarily utilized, and some bias due to differences in the age of facilities and equipment results. Interest, the second component of "rental cost" as an expense item, is included in the operating cost data, but it should be noted that none of the study capital expenditures were financed primarily through debt.

(b) Measurement of Direct Costs

In an attempt to improve the generalizability of the direct cost data, a systems analytical approach was utilized, focusing on staffing as the major input factor. The department's staffing patterns by shift and day of the week, and broken down by personnel class, were documented via interview. The staffing patterns were then converted to FTEs, allowing for coverage of vacation, sick leave and holiday time in accordance with the department's policies (some departments set staffing patterns high enough that a missing position will not have to be replaced, others have an additional employee(s) on the payroll with which to fill in for absences). Programmed FTEs determined in this manner were then compared to actual FTEs from payroll records (it is such payroll data that determine salary cost as reported on the Medicare Cost Report).

Significant discrepancies between programmed and actual FTEs were encountered, some of which had not come out in the interviews. Corrections were made accordingly, the goal being not to artificially define what an efficient staffing level or pattern should be, but to adjust for aberrations in the data from one period of time which do not reflect the staffing policies of the department. The types of discrepancies between programmed and actual FTEs for which adjustments were made include:

- Employees who split their time between departments but are carried as employees of one department on the payroll. A multi-hospital system was included in the study, and employees similarly split their time between two hospitals but were carried on the payroll of one or the other.
- Employees who are temporarily reassigned to different units on a day-to-day basis. This occurs frequently on inpatient units, where inter-unit transfers are utilized to adjust for fluctuations in census and nurse dependency by unit. While this is an effective technique for minimizing staffing needs, if the "in" and "out" personhours are not equal over time, the salary data emanating from payroll will not be accurate by unit.
- Systematic use of outside employees to cover for absences. This again refers primarily to inpatient units, where a pool or "floats" are used for substitutions.
- Positions unfilled for a significant length of time due to unavailability of qualified personnel. While turnover is a normal phenomenon, the effects of which are nearly always reflected in cost data, one instance of a very unusual turnover streak was encountered, which would have presented an artificially low staffing cost.
- Decisions to change staffing (i.e. permanently add or delete a position) made late in the period of analysis. The policy of the department at the end of the period was extended over the entire period for analysis purposes.

In order to carry out this analysis, actual paid hours by personnel class are needed as well as average salary rates by personnel class with which to convert hours to dollars. These data were not always available; significant amounts of time on the part of the project staff and/or hospital staff were needed in some cases to produce useable data.

A more complex methodology is required when the operating costs associated with a capital expenditure that does not produce a new department or inpatient unit is contemplated. This was done in the case of the linear accelerator studied, which was added to an existing radiation therapy department. A person-by-person analysis of time spent in activities related to different groups of patients was necessary in this case.

The other components of direct costs are depreciation, employee health and welfare benefits, and "other," including such items as office supplies, instruments (not expensive enough to capitalize), staff travel and education, and insurance. Depreciation was imputed from 1977 capital expenditure data, as mentioned above, and actual costs were used for the other two components. The only problem encountered, which is a matter of non-comparability of practice among hospitals and services rather than inaccurate data, was that medical/surgical supplies (such items as intravenous fluids, bandages, and thermometers) are sometimes purchased directly by the department (in which case they are direct costs) and are sometimes routed through Central Services and Supplies (in which case they are indirect costs).

(c) Measurement of Indirect Costs

This discussion first requires a clarification of terms. Hospital departments are generally divided into inpatient and outpatient departments (revenue-producing patient units and clinics), ancillary departments (revenue-producing services serving both inpatients and outpatients, such as diagnostic radiology and EKG), and general service departments (non-revenue-producing services provided in support of all patient care services, such as administration and housekeeping). The principles of cost accounting (as applied in hospitals and other industries) generally provide for the costs of non-revenue-producing departments to be allocated to revenue-producing departments on the basis of the distribution of output utilized. The concept is illustrated by an example for a dietary department, which normally has number of meals served as its unit of output.

Dietary costs - $1,000

Dietary meals served - 100

Departments Using Dietary Services	Meals Served	Costs Allocated
Renal Dialysis	20	$ 200
Medical/Surgical Unit	50	$ 500
Intensive Care Unit	30	$ 300
	100	$1,000

This concept of allocation was used throughout the study. However, because revenue-producing departments also utilize the services of other revenue-producing departments (e.g., laboratory tests ordered for renal dialysis patients or ICU patients), the approach was extended to all hospital departments providing services used by the departments under study.

The bases of allocation (i.e., units of output or proxies for output) used for the Medicare Cost Report were used as the starting point for determining the share of general service and ancillary costs devoted to producing services for the study departments. Changes in the base or method of allocation were made for several different reasons:

- In some cases the base of allocation accepted for Medicare reporting was considered less accurate, at least in relation to the study service, than an available alternative base. For example, the base of allocation for utilization review (a component of administration and general) was changed several times from charges to admissions. The former assumes that the time spent in review is a function of the number and costliness of services received by the patient, which is usually not the case.
- In a few instances, the base of allocation recommended for Medicare reporting was not used by the hospital, and the substitute base was less accurate. A change back to the recommended base had to be made.

- In several instances, the base of allocation was conceptually accurate (or at least represented the best base immediately available), but the study department placed unusual demands on the support service, such that the "true" cost was understated. Examples are:

  .. A maintenance employee required daily for machine start-up and maintenance.

  .. A business office clerk utilized full-time for a separate patient registration and charge handling desk for the study service.

  .. Ancillary personnel (e.g., occupational therapists) assigned full-time to the study service. With unavoidable downtime, the cost of permanent placement is often higher than is reflected by using charges for specific services rendered as the base of allocation. The alternative approach in cases such as these was either to construct the costs (e.g., salary and fringe benefits for the employee assigned to the study service, plus a share of non-salary costs) or to pull specific costs (such as salary for a specific number of hours spent) out of a support department's costs before allocation, then adding the costs back to the study service after allocation.

  It should be noted that few instances of systematic over allocation were documented. Such situations are much more difficult to uncover via interview, and several may have been overlooked.

Given the objective of measuring social incremental costs, the allocation of indirect costs according to the Medicare recommended bases of allocation, adjusted frequently as above, provides a reasonably accurate methodology. Two notable exceptions to this premise should be noted. The first is the cost center commonly known as "administration and general." This is a catch-all category of services usually applicable to all patient care services (e.g. top administration, accounting, admitting, personnel, data processing, utilization review, medical staff office, and switchboard). Accumulated costs is the normal base of allocation, and the distribution of costs may be grossly inaccurate. Accuracy varies considerably by component of the cost center, but at the extreme, no service at all is provided to departments receiving a

normal "share" of such costs. For example, admitting and utilization review are generally entirely inapplicable to outpatient departments, but such costs are still so allocated. Some useful corrections were made in this study by separating out the components of administration and general, but a detailed component-by-component analysis was not practical.

The second problem area is allocation of all ancillary services on the basis of aggregate charges (commonly known as the ratio-of-charges-to-charges-applied-to-costs, RCCAC, method). Using charges as a proxy for costs is theoretically an accurate method of allocation, because the cost of producing a given test or procedure is appropriately allocated to the department caring for the patient for whom the test or procedure was ordered. But accuracy rests on the presumption that charges are established on the basis of actual costs, which they often are not due either to lack of extensive analysis of the costs of producing given tests and procedures, or due to purposeful strategies to maximize revenue through various cross-subsidizations.

Two other issues were encountered in connection with allocation of ancillary costs. First, assuming that charges is the best base of allocation, charge data specific to the patients served by the study service are necessary. In several instances, such data were not available. In one case the data were assembled by summing from patient logs; in other cases there was no practical way of obtaining the data and the much less accurate base of direct costs had to be used. Aggregate charges account for differences in case-mix (subject to the accuracy of the charge/cost relationship by item as above), while direct costs do not.

The second issue was an instance (specifically the linear accelerator) where not all ancillary services consumed by the patients treated in the study service are appropriately allocated to that service. Only those tests which are part of the protocol for treatment via the linear accelerator should be so allocated.

This issue was handled by simulating the RCCAC formula separately for each test included in the department's protocols, rather than using aggregated charges from patient billing records.

The Medicare Cost Reports as a Data Source

Select pages of the Medicare Cost Report, a 30-40 page report required annually of all participating hospitals for determination of Medicare and in some cases Medicaid reimbursement, was used as the primary cost data source for this analysis, largely because it is the only systematically available data source. Some of the problems with this document as a source of data for research efforts such as this one are summarized below:

- Several of the cost centers are, by design, aggregations of departments not similar in terms of inputs or nature of services provided. Administration and general is one such cost center, as discussed above, and "adult and pediatrics" is another. Units such as pediatrics, medical-surgical, inpatient psychiatric, etc., all included within the category unless the hospital takes the initiative to separate them out, are very dissimilar in nature.
- The functional cost centers suggested by the HCFA forms are not adhered to. Hospitals routinely substitute cost center titles, add cost centers to the basic form, combine cost centers, and in fact substitute forms which display up to twice as many cost centers as are provided for on the HCFA forms. This is largely a function of the organization of cost centers for management rather than reporting purposes, and the relative merits of uniform cost reporting and/or accounting are beyond the scope of this project.
- Physician fees in ancillary departments are excluded from the display of costs by cost center. While they are listed on a separate form in most cases, when physicians bill patients separately the costs are not reported at all. Non-comparability among hospitals results (this factor was corrected through an imputing procedure for the current study).
- The allocation of ancillary costs extends only to the point of a single division between inpatient and outpatient activity. Thus, the full costs (direct plus indirect) of specific inpatient services (e.g. ICU,

burn care unit, medical/surgical) cannot be determined from the report. Similarly, no provision is made for allocation of costs from one ancillary service to another, so that the total costs of services such as radiation therapy and renal dialysis also cannot be determined.

Extension of the Methodology

Three types of extensions to the methodology developed in this project would be worthy of consideration in future research efforts, in addition to the possibility of measuring private incremental rather than social incremental costs, as alluded to earlier. The first is measurement of the tertiary cost impacts of the capital expenditures under study. Indirect or secondary cost impacts as measured in this study have repeatedly been referred to as relating to "services provided to" or "services provided in support of" the study service. Tertiary impacts, on the other hand, may occur as the result of the capital expenditure, but cannot be considered as part of the cost of operating the study service. One example is the emergency room. Addition of a service such as burn care may result in additional emergency room utilization and hence costs, because many patients will enter the burn care unit via this entry point. Similarly, burn care patients may require follow-up medical-surgical care, and it is logical to presume that a significant portion of such care will be obtained in the same hospital. Another important example is the inpatient psychiatric unit, where a high percentage of patients will likely seek outpatient psychiatric care at the same hospital when the need for acute care services subsides. Further, medical problems may be uncovered as a "by-product" of their psychiatric care, and these needs may also be attended to at the same hospital. Such tertiary cost impacts are documented as applicable in Chapter 3, but quantification of the impacts was not undertaken.

Two of the most important factors affecting the generalizability of the data produced by the methodology of this study are differences in production costs (i.e., technical and economic efficiency) and differences in utilization rates. Short of a very large sample size by

which mean costs could be determined, the former factor can only be addressed by detailed management engineering studies. It is unlikely that such an approach would be cost-effective. Differences in utilization rates, however, could be normalized by projecting costs to a desired level of output. Such a projection would not be linear, but by "budgeting" the major variable input factors, particularly staffing, at the optimal output level given capacity constraints, a reasonably accurate simulation could be developed. The department manager would be the primary source of information for this analysis. The optimal and observed rates of utilization for each of the five study services are discussed in Chapter 3, so as to alert the reader to potential biases in this regard.

The third possible extension of the methodology would be to measure externality effects (i.e., effects beyond the institution in which the capital expenditure was made). This would include changes in utilization and hence costs of other providers, access to care, continuity of care, etc. Such effects are far reaching, and the cost-effectiveness of analyzing them should be carefully scrutinized.

2

FINDINGS AND USE OF THE STUDY

The purpose of this chapter is to summarize the operating and capital cost data for the five services studied, to identify factors affecting the generalizability of such data to other studies of the same kind, and to preliminarily address the use of this type of data as well as the methodology developed in the study by planning agencies, hospitals, and Federal researchers and policy-makers. A more detailed analysis of the data and its generalizability by service is presented in Chapter 3.

Summary of Findings

Figure 2 summarizes the operating and capital cost data for the five services (separate data are presented for the Standard and Limited Care Dialysis Units which are operated as a system) in absolute dollar and ratio form. It is important to reiterate that the capital expenditure data (including depreciation as a direct operating cost item) have been projected to 1977 dollars for comparability between capital and operating costs, and the capital expenditures for development of a service by renovation rather than full construction (applicable to the Burn Treatment Center and Renal Dialysis Units) have been imputed for comparability among the services. The methodologies used for these normalizing adjustments are documented in Chapter 1.

Three statistics have been calculated for comparison among the services: the ratio of indirect to direct operating costs, the

	Burn Treatment Center	Linear Accelerator	Inpatient Psychiatric Unit	Standard Renal Dialysis Unit	Limited Care Renal Dialysis Unit	Medical/ Surgical Unit	Shock/ Trauma Center
Operating Costs							
Direct	$1,182,766	$ 235,990	$ 696,824	$ 820,232	$ 314,513	$ 624,048	$ 4,538,733
Indirect	1,803,173	81,186	788,456	474,027	212,300	1,331,148	2,631,626
Total	$2,985,939	$ 317,176	$1,485,280	$1,294,259	$ 526,813	$1,955,196	$ 7,170,359
Ratio of Indirect to Direct Costs	1.52	.34	1.13	.58	.68	2.13	.58
Operating Costs Per Unit of Output	$642.14 per Patient Day	$42.10 per Treatment	$150.47 per Patient Day	$179.73 per Treatment	$155.49 per Treatment	$182.51 per Patient Day	$770.00 per Patient Day
Capital Expenditures							
Building	$ 849,866	$ 253,011	$ 528,719	$ 293,264	$ 195,593		
Fixed Equipment	205,797	68,837	84,088	7,602	10,319	$1,076,249*	$ 2,268,371*
Moveable Equipment	225,979	195,349	124,695	319,021	73,605	72,647	979,822
Total	$1,281,642	$ 517,197	$ 737,502	$ 619,887	$ 279,517	$1,148,896	$ 3,248,896
Ratio of Operating Costs to Capital Expenditures	2.33	.61	2.01	2.09	1.88	1.70	2.21

FIGURE 2: SUMMARY OF OPERATING COSTS AND CAPITAL EXPENDITURES BY SERVICE, 1977 DOLLARS

* Includes Building and Fixed Equipment

cost per unit of output, and the ratio of total operating costs to total capital expenditures.

Substantial variability is exhibited in the ratios of indirect to direct costs among the five services. Subject to verification by extension of the methodology to more hospitals and more types of hospital services, three tiers in this ratio are suggested by the data: (1) relatively low ratios for the highly outpatient-oriented ancillary services (Linear Accelerator and Renal Dialysis)[1/], (2) medium-level ratios for specialty inpatient services (Inpatient Psychiatric Unit and Burn Treatment Center), and (3) relatively high ratios for general inpatient services (Medical-Surgical Units). The primary factor in the low ratio for the outpatient-oriented services is, of course, the lack of need for 24-hour care (bed-space, dietary, bed-side nursing, etc.). On the inpatient side, the specialty units are characterized by concentration of resources of different kinds and generally high intensity within the unit itself. The Burn Treatment Center, for example, makes considerable use of ancillary services, but also requires an unusually high nursing and auxiliary staff to patient ratio and employs hospital-compensated physicians. The Inpatient Psychiatric Unit similarly has a high staff to patient ratio and utilizes hospital-compensated physicians, and in addition, the unit has several personnel usually employed outside of the inpatient departments (e.g., social workers, psychologist). The Medical-Surgical Units studied, on the other hand, have a lower staff to patient ratio within the unit, but patients heavily utilize

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[1/] Ancillary service in this context refers to a department which provides services to both inpatients and outpatients. The two ancillary services in this study, however, differ from most others in that they provide the primary mode of treatment for the patients they serve. Further, the hospital-based physicians in these departments take substantial, if not exclusive responsibility for the management of patients' care. Most other ancillary services, such as diagnostic radiology, laboratory, inhalation therapy and EKG, play a more supportive role in the management of patients by physicians in other inpatient and outpatient settings.

all ancillary services of the hospital. Further, in accordance with common practice in community hospitals, all patients are treated on a fee-for-service basis by their private physicians and the cost of physician care is therefore not reflected in the data.

As would be expected, the total cost per unit of output varies across a very wide range by type of service. It is useful to note, however, that the intensive nature of renal dialysis treatment produces a per unit cost in the same range as numerous inpatient services, despite the fact that over 85 percent of the patients (at least in the study units) are treated on an outpatient basis.

The ratios of operating to capital expenditures also vary significantly across the services studied, but to a considerably lesser extent than the ratios of indirect to direct costs. Among the three inpatient services studied, the high observation was found for the Burn Treatment Center. This unit has both the highest per unit operating costs and highest per unit capital costs of the study services, but the intensity of non-capital inputs turns out to be the dominant factor. The low observation was the Medical-Surgical Units. However, as will be discussed further below, the operating cost data for this type of service is particularly non-generalizable due to the effect of case-mix differences, and comparison with the other services on the basis of the operating/capital cost ratio should therefore be avoided.

In line with the above observation that renal dialysis costs per unit of output are comparable to those of many inpatient services, the ratio of operating costs to capital expenditures for this service is also in the same range as that of the inpatient services studied. The lowest operating/capital cost ratio among the study services was the other outpatient-oriented service, the Linear Accelerator, which is attributable primarily to the expensiveness of the machinery required. It might be hypothesized that ratios of a similar magnitude would apply to several other high-technology ancillary services, such as the CAT scanner (particularly if analyzed separately from the diagnostic-radiology department

within which it is often organized), electroencephalography, and nuclear medicine. A similar outcome would not be expected, however, for most outpatient services. While not addressed in this exploratory study, the ratios for ambulatory care departments might well prove to be quite comparable to those of inpatient services.

Figures 3 through 8 display the breakdown of operating cost impacts for each study service among the ancillary and general service departments (or groups of departments) and the major components of direct cost. The relative magnitude of cost impacts across these divisions varies substantially, but a few general observations can be made. Despite the fact that total indirect costs are larger than total direct costs in two cases, departmental salaries is on average the largest single cost component, and in all cases except the Inpatient Psychiatric Unit, "other direct costs" also ranks as a substantial cost impact. This coupled with the fact that social incremental costs as measured in this study are likely to be nearly the same as private incremental costs within the department of the capital expenditure implies that these direct cost items will warrant particular attention in any prospective analysis of a service enhancing capital expenditure.[1/]

Among the general services, three departments consistently showed a substantial impact: Administration and General, Maintenance and Operation of Plant, and Housekeeping. Among the ancillary services, a pattern cannot be discerned with the limited data available, and even the normal expectation that Laboratory and Diagnostic Radiology would provide the greatest impact does not always hold up. As discussed in the "Methodology" section of Chapter 1, particular caution is urged in assessing the data for the Administration and General category and many of the ancillary departments due to measurement constraints.

1/ Social and private incremental cost impacts are contrasted in the "Conceptual Approach" section of Chapter 1.

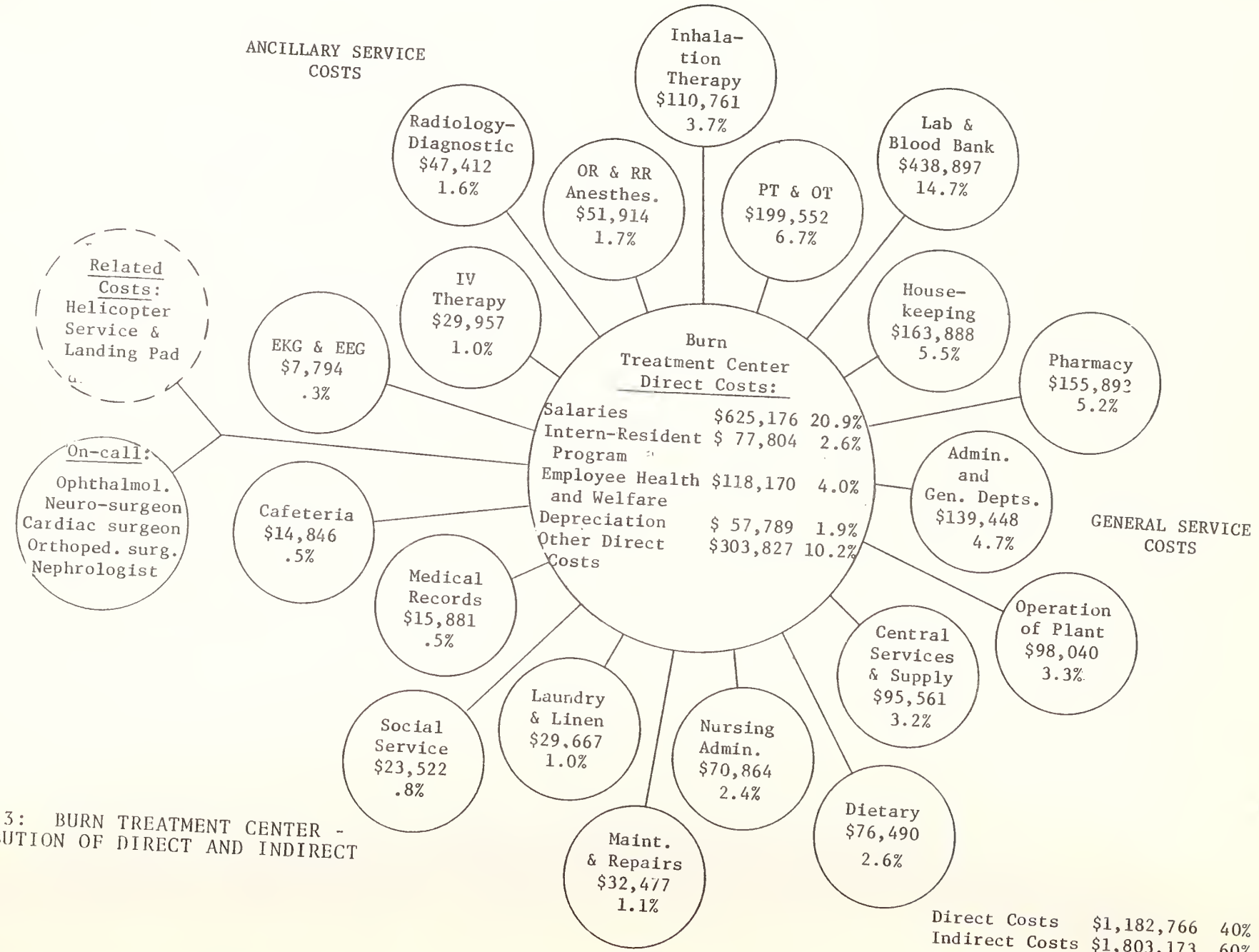


FIGURE 3: BURN TREATMENT CENTER - DISTRIBUTION OF DIRECT AND INDIRECT COSTS

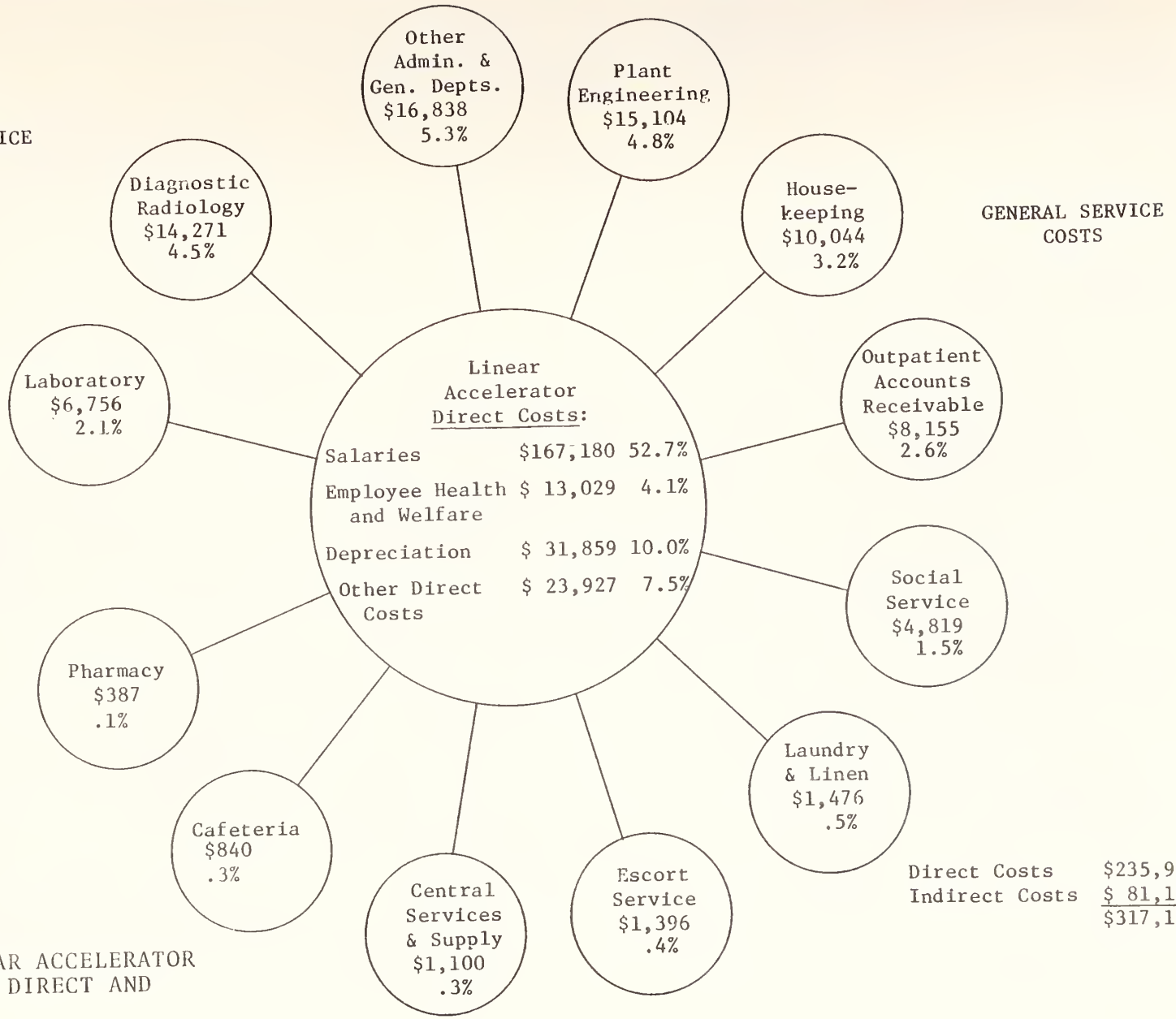


FIGURE 4: LINEAR ACCELERATOR DISTRIBUTION OF DIRECT AND INDIRECT COSTS

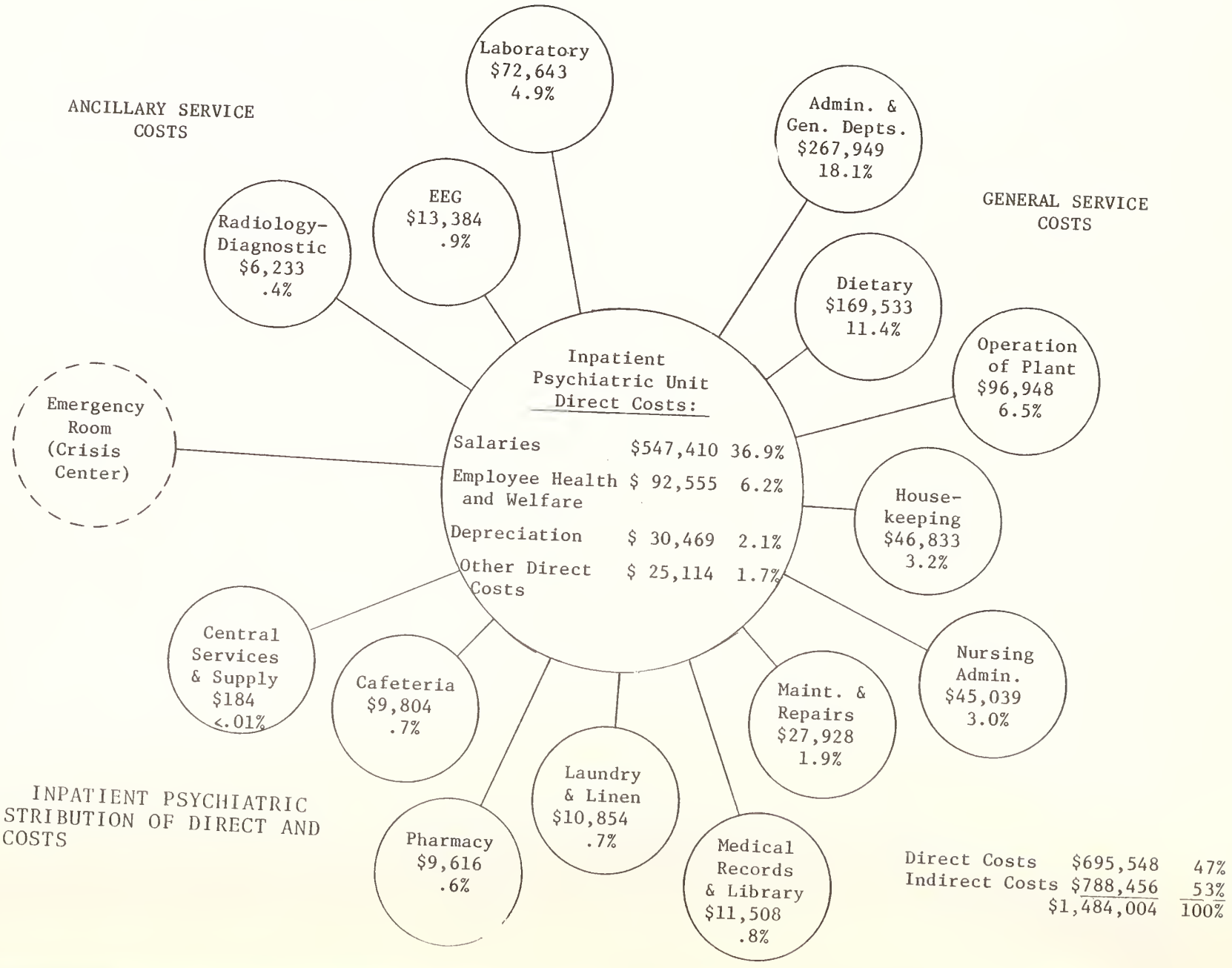


FIGURE 5: INPATIENT PSYCHIATRIC UNIT - DISTRIBUTION OF DIRECT AND INDIRECT COSTS

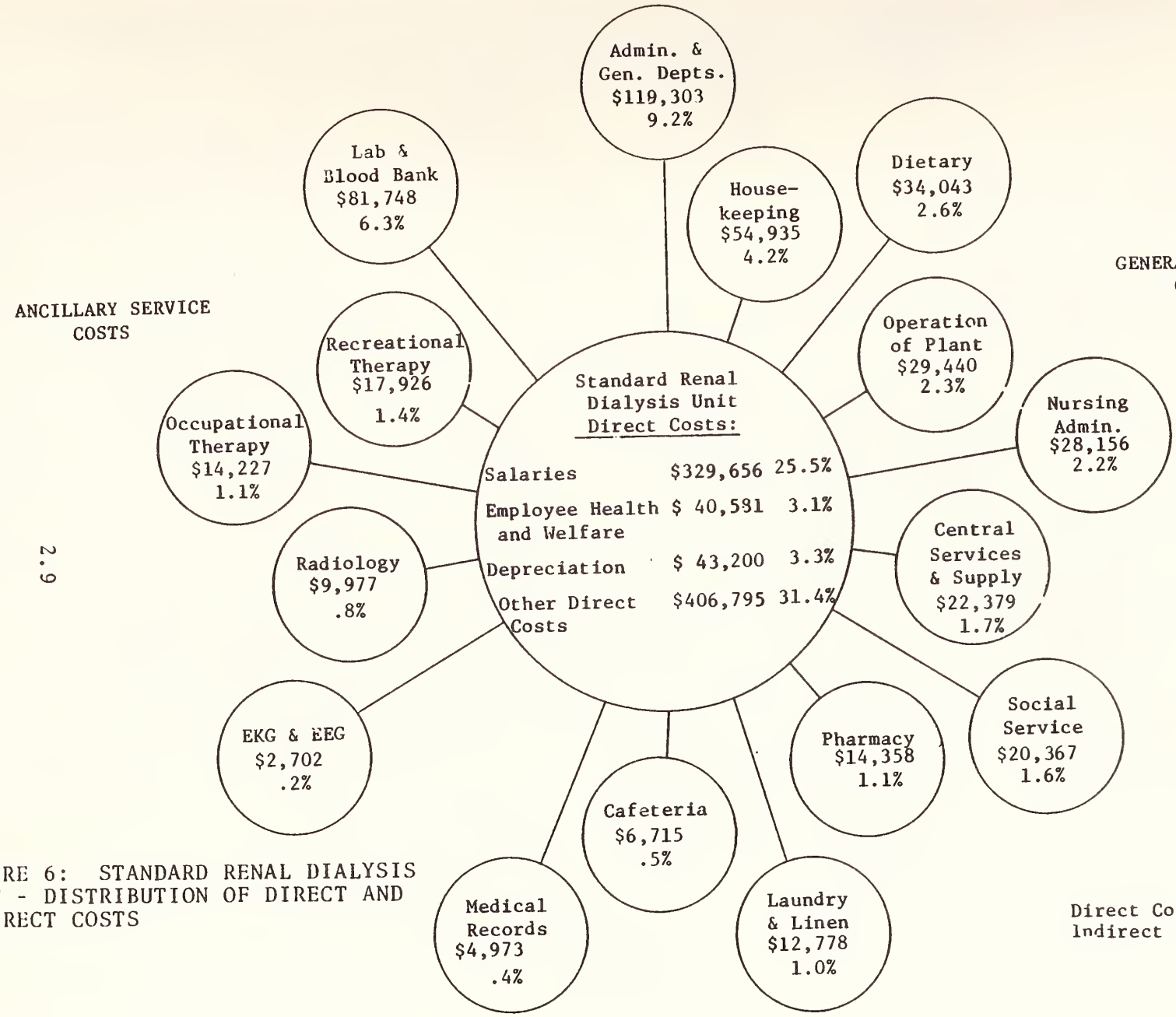


FIGURE 6: STANDARD RENAL DIALYSIS UNIT - DISTRIBUTION OF DIRECT AND INDIRECT COSTS

Direct Costs	$820,232	63%
Indirect Costs	$474,027	37%
	$1,294,259	100%

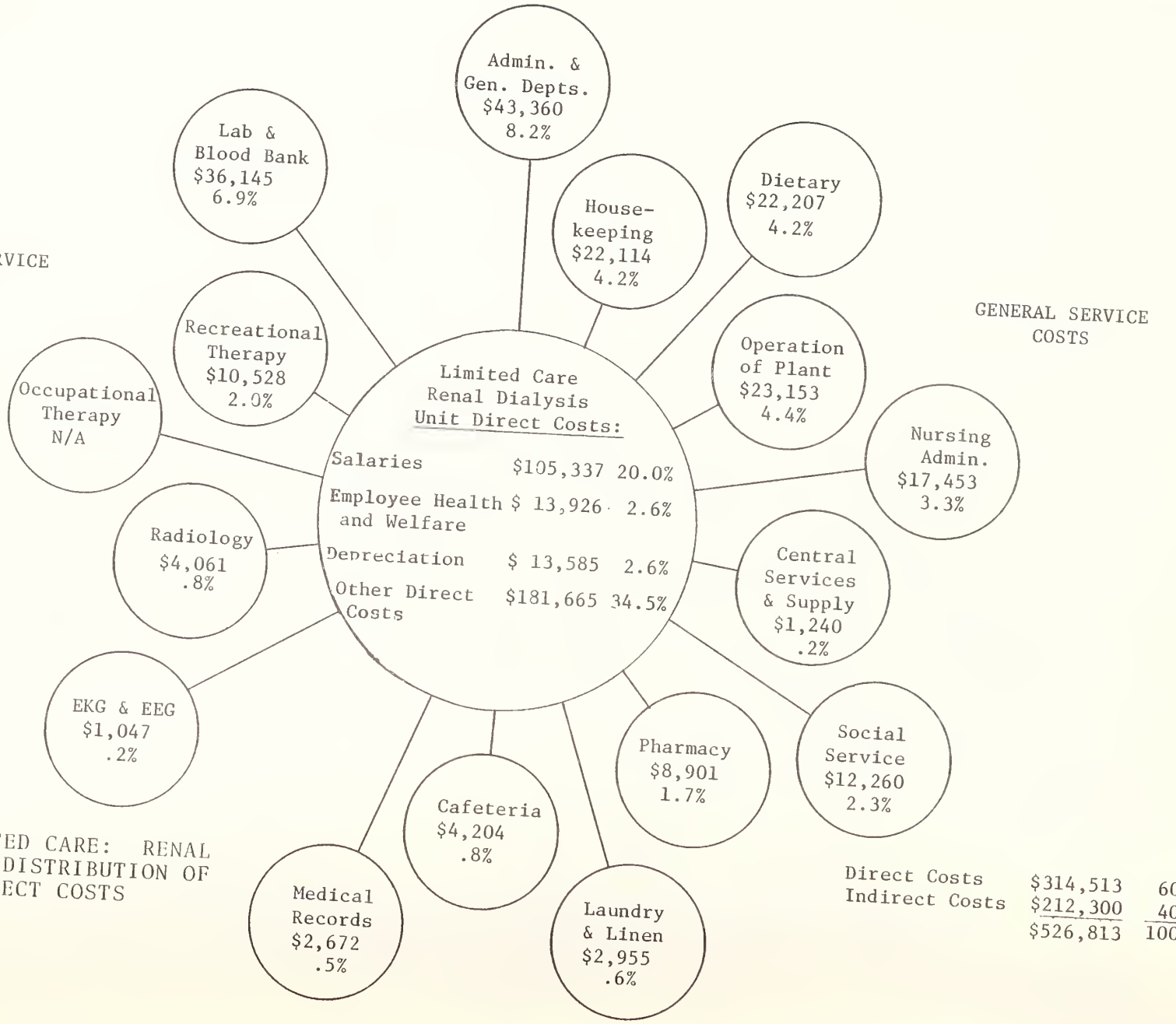


FIGURE 7: LIMITED CARE: RENAL DIALYSIS UNIT - DISTRIBUTION OF DIRECT AND INDIRECT COSTS

Direct Costs	$314,513	60%
Indirect Costs	$212,300	40%
	$526,813	100%

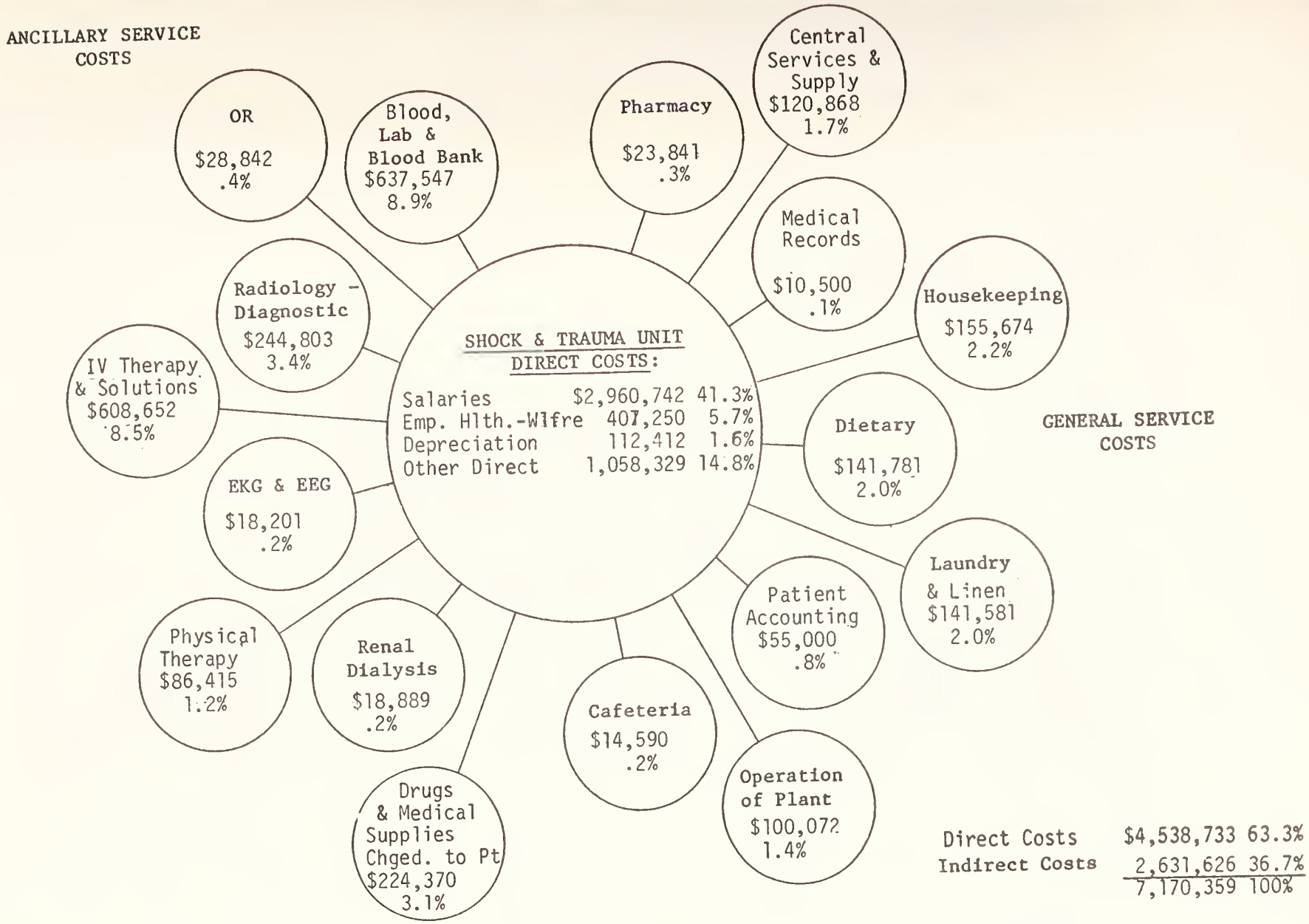
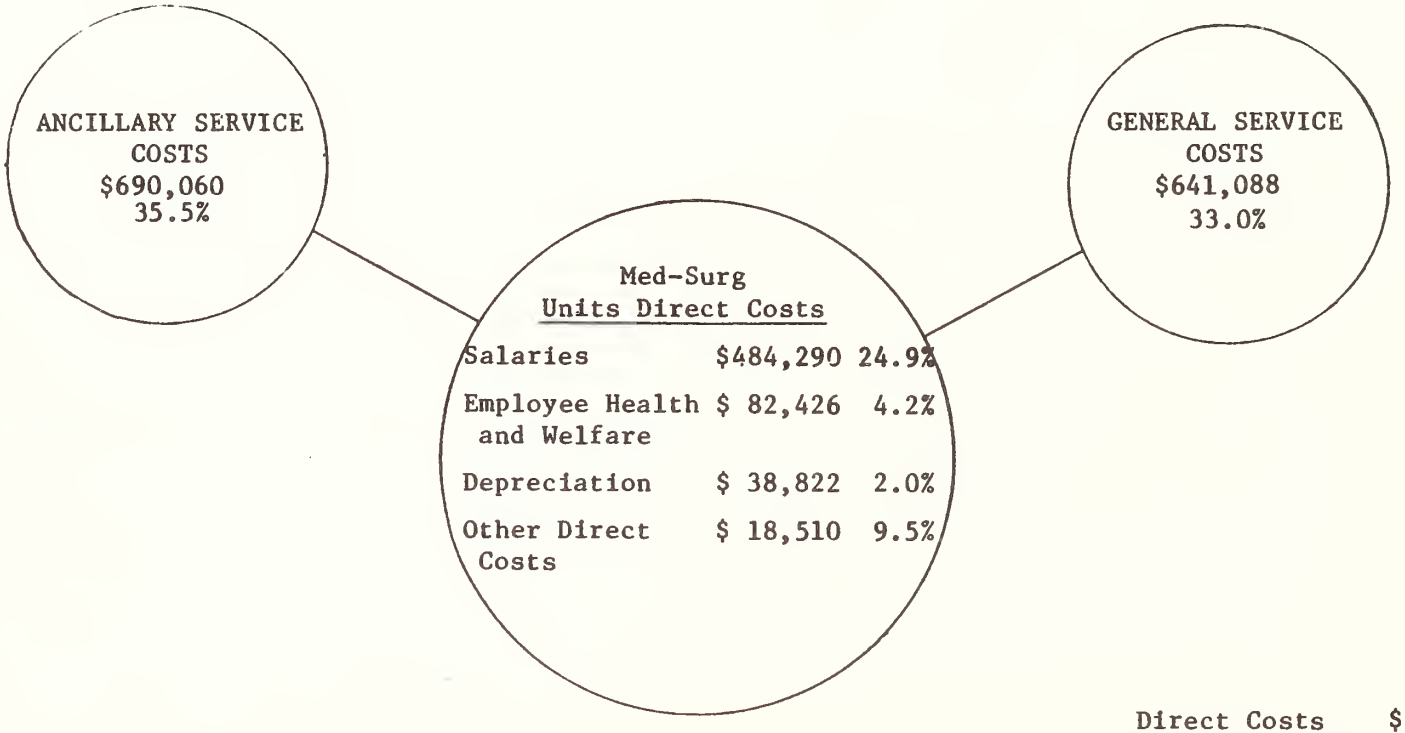


FIGURE 7a: SHOCK-TRAUMA CENTER - DISTRIBUTION OF DIRECT AND INDIRECT COSTS



Direct Costs	$ 613,086	32%
Indirect Costs	$1,331,148	68%
	$1,944,234	100%

FIGURE 8: MEDICAL/SURGICAL UNITS - DISTRIBUTION OF DIRECT AND INDIRECT COSTS

Generalizability of the Findings

Several major factors affecting the generalizability of both operating and capital cost data developed using the methodology of this study are discussed below. Each factor is discussed in general terms followed by reference to the data presented in this report for the five study services.

(a) Level of Utilization

A factor with the potential for significant bias in a comparison among hospitals is the level of utilization, or percent of capacity, at which the services are operating. As the level of utilization increases, cost per unit of output decreases, ceteris paribus, because the cost of fixed inputs is spread over a greater number of output units. But the ratio of operating to capital expenditures increases with higher levels of utilization, as variable costs are incurred to handle the additional volume. The standard by which utilization is assessed is not capacity (e.g., 100% occupancy on an inpatient unit), but the "optimal" rate of utilization which balances minimization of operating costs with the flexibility needed to handle random fluctuation in volume and trends in volume on a seasonal and day-of-the-week basis.

All three of the inpatient services studied were operating at average occupancy rates that could be considered near the optimal level. The two outpatient-oriented services, however, may be considered to have been operating below the optimal level, but the definition of the optimal level in both cases is unclear. In the case of the Linear Accelerator, the daily treatment load during the period of analysis was 29 percent below the level at which the department believed it could operate on a sustained basis, but the patient load had been steadily increasing since introduction of the machine. The hospital may elect to purchase additional equipment, possibly with the dual objective of expanding capacity and expanding the range of clinical capabilities, before this

maximum treatment load is reached and sustained for any length of time. The two Renal Dialysis Units present an interesting scenario, because the Standard Unit operated at near capacity on a two-shift basis while the Limited Care Unit operated virtually at capacity on a one-shift basis. The conclusion that the level of utilization biases the data for the Limited Care Unit therefore rests on the assumption that the unit "should" be operating two shifts.[1/] But, again, demand has been increasing over time, and the excess capacity will probably be utilized in the near future. In both the cases of the Linear Accelerator and the Renal Dialysis Units, the level of utilization was lower than standards that might be utilized as the starting point for area-wide planning and the generalizability of the data is affected accordingly, but the local supply and demand situation, not unlike the situation in many localities, may have dictated the need for the observed excess capacity.

(b) Patient-Mix

The type and complexity of cases treated will greatly influence the resources needed for patient care. Diagnostic case-mix is generally the key factor, but the mental and physical condition of patients with given diagnoses will also affect resource requirements (e.g., aged patients requiring additional nursing care for incontinence and assistance with eating). Generally, patient-mix has less of an effect on the generalizability of cost data for specialty services, because the types of patients treated are limited in scope and the protocols for treatment are therefore more narrowly defined. However, Medical-Surgical Units handle a wide variety of diagnoses and conditions. Direct costs for medical-surgical care will vary from hospital to hospital within a reasonably small range, but the type and quantity of ancillary services required will vary dramatically. As a result, the cost of ancillary services for the study Medical-Surgical Units must be considered almost entirely non-generalizable.

1/ It is interesting to note that if the limited care unit had been operating at full capacity on a two-shift basis, its ratio of operating to capital expenditures probably would have been the highest of the services studied.

(c) Treatment Regimen

The resources required for treatment of a given type of patient (i.e., patient-mix held constant) may vary according to the philosophy of the physicians responsible for medical direction in the unit or the physicians treating patients privately in the unit. Differences in treatment regimen are related to both efficiency and quality of care, and such differences may be evidenced in the type and quantity of ancillary services obtained from other departments as well as the resources utilized for patient care in the unit itself.

One significant instance of a choice among alternative treatment regimens was found among the study services. In the Burn Treatment Center studied, the removal of burned skin, known as debriding, is accomplished surgically in contrast to a soaking technique used by many other burn care units. Further, because both debriding and the "harvesting" of live skin from the patient for grafting are done for large areas of the body at one time, the procedures are performed in the hospital's operating rooms under a general anesthetic rather than in a minor operating room located in the unit itself, as is the policy of some similar units. These differences obviously have an impact on the nature of facilities and staff required for burn care.

(d) Input Prices

Salary levels, construction and equipment prices, and the prices of other inputs will vary by region of the country and to some extent from hospital to hospital. However, regional price variation will affect the generalizability of the ratios of operating to capital expenditures only to the extent that price patterns differ for facilities and equipment (capital costs) versus personnel, supplies, insurance, etc. (operating costs). In utilizing the data developed in the study, adjustments could be made for regional price differentials, because the location of each hospital has been provided. Further, average salary levels by personnel class within the study departments have been listed in Chapter 3, such that adjustments for direct labor costs, the single largest component of cost as noted earlier, could be made for a detailed analysis tailored to a specific hospital.

(e) Efficiency

Efficiency in this context refers to the inputs required to produce a given output. If this factor were hypothetically measured as cost per unit of output, with differences in the level of utilization, patient-mix, quality of care, and input prices held constant, then the primary subfactors influencing cost would be technical efficiency (referring to use of productive techniques), economic efficiency (referring to utilization of an appropriate mix of resources encompassing facilities, equipment, personnel and other inputs) and economies of scale (referring to the optimal facility size). Emphasis was not placed on assessment of efficiency in this study, but the number of professional personnel within the study departments, by personnel class and in total, was compared to "suggested" staffing levels for similar services and similar volumes of patients found in the literature. Although the analysis was constrained by the limitations of the data available for comparative purposes, no differences in staffing were found to suggest that the data from the study hospitals are not reasonably generalizable.

(f) Type of Construction and Age of Facilities

Beyond regional differences in construction prices, the capital expenditures for the study departments measured in terms of social incremental costs will vary according to whether the structure was built separately as or as part of a larger construction project, and according to numerous other local factors such as whether it is a single floor or part of a tower, the grade of the landsite, the quality of the building materials utilized, etc. Three of the five study services were constructed as part of larger projects (but not as part of the construction of an entire hospital), and the other two were implemented by renovation of existing space, which necessitated imputing the construction costs to avoid total lack of generalizability. The relationship between the construction costs of the study services and averages for similar types of facilities is in fact not known.

The type of construction as well as the age of the building in all parts of the hospital affect the generalizability of the operating cost data by influencing the requirements for maintenance, housekeeping, security, and utilities. Moreover, the age of facilities determines the amount of depreciation contained in the indirect cost data (this factor was normalized for direct costs by the projection of all capital expenditures to 1977 dollars).

Use of the Findings and Methodology

Given the decision to measure social incremental rather than private incremental costs, the potential use of the results of this study and similar research efforts that might be undertaken are briefly summarized below by user. In terms of actual data, "results" may refer to the operating costs, operating costs per unit of output, the ratio of operating to capital expenditures, and the ratio of indirect to direct costs.

(a) Federal researchers and policy-makers interested in a national limit on capital expenditures

The data presented in this chapter exhibit the wide divergence in the ratio of operating to capital expenditures for different types of services, which underscores the difficulty of trying to predict the aggregate operating cost impact of a given level of capital expenditures. Moreover, two factors further complicate this objective. First, it is the mean private incremental cost that would predict the effect of a national ceiling on capital expenditures. While it may be hypothesized that the mean of private incremental cost impacts approaches social incremental costs as measured in this study, the relationship between the two has, in fact, not been ascertained. Secondly, capital expenditures for new services may be in the form of renovation of existing space rather than construction of new facilities, and capital expenditures may also be for the purpose of modernization of facilities without affecting or even decreasing service capacity. The number of permutations

appears endless, and the prognosis for quantifying a single relationship between capital expenditures and operating costs at the national level accordingly does not appear bright. However, analysis of the operating cost impact of specific types of capital expenditures, such as simulation of the effects of categorical construction grants, would be facilitated by use of the methodology developed in this study, extensions to the methodology, and a methodology for measuring private incremental cost.

(b) Planning Agencies

Because social and private incremental costs are generally similar in magnitude within the direct cost category, as discussed in Chapter 1, direct cost data such as that developed in this study should definitely be of interest to planning agencies. Such data, as well as the supporting narrative information explicating the type of service provided, input factors and utilization, should be useful in assessing proposals for new services or gauging the cost of programs the agency desires to promote or fund through the Area Resources Development Fund.[1/] While definitely not to be construed as "standards," the data would provide a starting point for comparison.

The indirect cost data should be of interest in general terms because the analysis identifies the types and relative magnitudes of indirect cost impacts. Such information would generally be known by hospital representatives, but planning agency personnel often have less relevant field experience than their hospital counterparts and also less time for detailed investigation. However, in terms of reviewing the reasonableness of proposed indirect cost predictions and assessing alternative proposals for a similar service, private incremental cost data is needed which can only be obtained from the hospitals involved.

By and large, the above comments would also be applicable to rate regulation agencies.

[1/] This fund is provided for in the Federal planning legislation but is not yet in operation.

(c) Hospitals

The direct cost data could provide useful information to administrators of hospitals contemplating major capital expenditures, but only at a general level. Much more detailed information would be needed, which normally would be obtained from experienced physicians and middle managers in the hospital, and from direct contact with other hospitals providing similar services.

The indirect cost data must be considered of relatively little use to hospital officials. General information regarding which hospital departments would be affected by a capital expenditure is important, but middle managers and administrative personnel will generally have the expertise to identify these impacts themselves. In terms of actually quantifying the impacts, private incremental costs are needed, and these must be investigated internally.

3

CASE STUDIES

BURN TREATMENT CENTER

Crozer-Chester Medical Center

Crozer-Chester Medical Center (CCMC) is located in Chester Pennsylvania near Philadelphia, and serves as a referral center for a large portion of the Delaware Valley. This private, non-profit institution emanated from the 1963 merger of Chester Hospital, erected in 1893, and Crozer Hospital, built in 1902.

The Medical Center occupies 25 buildings including 6 satellite locations providing a comprehensive variety of outpatient services. The main building houses 428 short-term beds. CCMC is affiliated with the Hahnemann Medical College and Hospital, located in Philadelphia, and supports numerous intern and residency programs.

Specialized Burn Care

People who are seriously burned as a result of accidents such as fire, explosions, corrosives, inhalation of toxic substances or gases, and sustained contact with high temperature material have multiple and complex needs. A burn care facility can best provide the staff, equipment, and environment to fulfill these needs.

The National Institute for Burn Medicine has defined three levels of burn care beyond general care and general intensive care, since neither of these levels has a consistent plan for burn management. The three levels correspond to degree of sophistication of treatment protocol and facilities. It must be noted, however, that these definitions are not universally accepted by burn care specialists. The most basic of these levels is the burn program, which provides specialized burn care in non-specialized facilities utilizing a consistent treatment plan. Burn units provide specialized care in a hospital area which has been designated exclusively for the care of burn victims. Treatment is based on a consistent burn management plan under the supervision of a surgeon. Burn centers provide care for the most severe cases and may be located within a hospital or may exist as a separate facility. The burn center generally serves as a major referral center for a large region.

Burn care may follow several alternative treatment philosophies which significantly affect the resources required in the burn care unit and in the hospital's Operating Room Department. The philosophy utilized by the study hospital will be placed within the context of the alternatives in the discussion below.

The Burn Treatment Center for Crozer-Chester Medical Center

The CCMC Burn Treatment Center was opened in November of 1973 in response to a well defined and documented need for such a facility in the Greater Delaware Valley area. CCMC and St. Agnes Hospital in Philadelphia, also granted approval for a burn center, work closely together and have entered into an indenture of trust agreement solidifying their intention of joint operational activity. The two centers compose the Burn Foundation of Greater Delaware County, an arrangement representing a formal sharing of responsibilities for acceptance of referrals and sponsorship of community education as well as other burn care related activities.

Referring to Figure 9, patients enter the Burn Treatment Center at CCMC from three sources: (1) admission through the hospital's emergency room, (2) transport from the site of injury by helicopter, and (3) transferral from another hospital via helicopter or ambulance. When a patient is taken from the site of inquiry by helicopter, a physician and a nurse from CCMC are on board. While in transit, assessment of the burn is made and treatment is initiated.

Once in the Burn Treatment Center, the patient is stabilized, and the burn size is estimated. A series of studies are conducted by the physician, and a physical examination is performed. A medical history is also prepared. If necessary, intraveneous fluid therapy is administered. Shortly thereafter, a social worker meets with the victim's family to explain the treatment procedures and to attempt to cushion the shock.

Explicit protocols are followed in the treatment process. The patient is weighed, bathed, debrided utilizing a surgical removal technique, and bandaged at least once per day by the nursing staff.

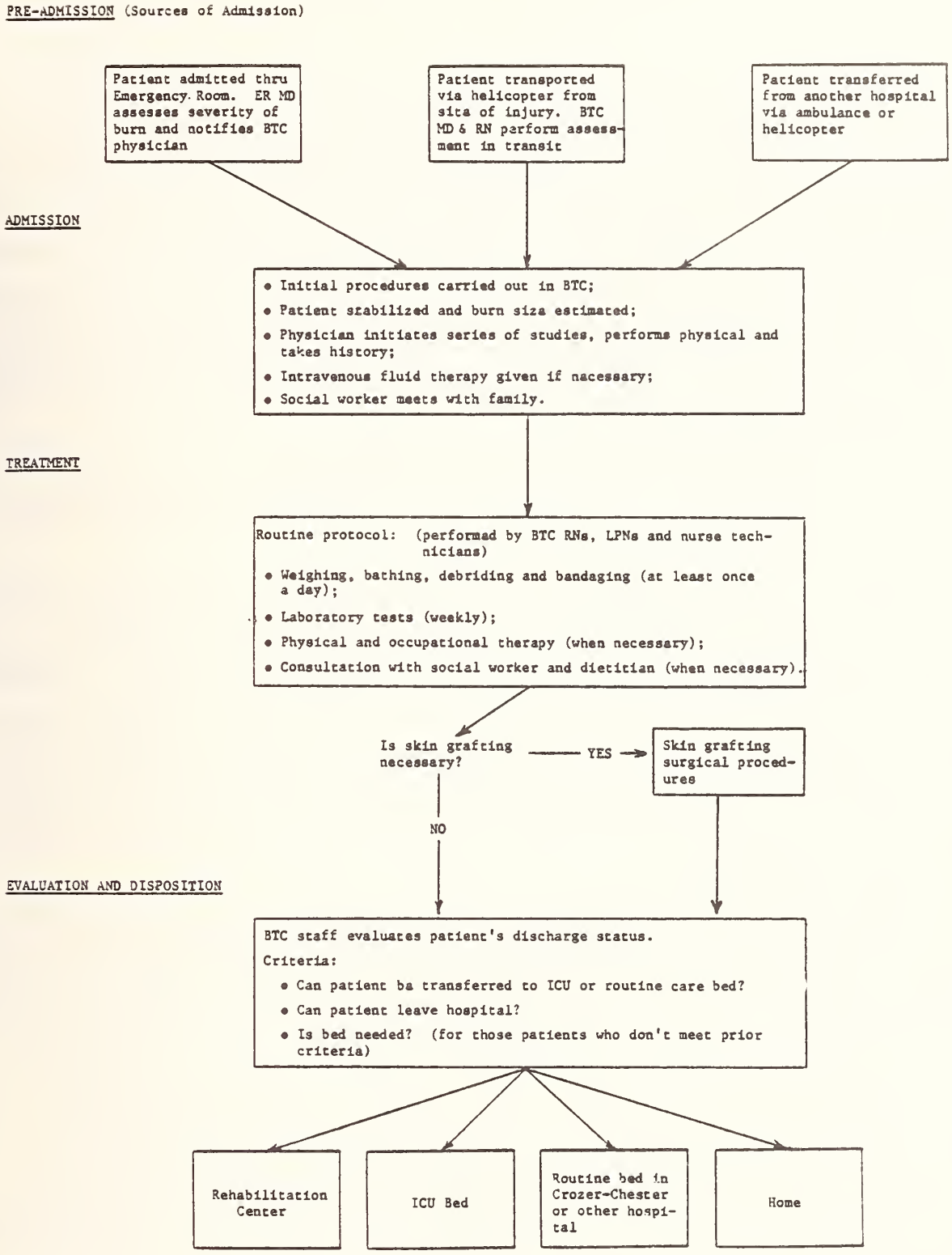


FIGURE 9: BURN TREATMENT CENTER (BTC) - EVENT-ORIENTED FLOW CHART

Weighing is extremely important to assure that there is proper fluid retention. Laboratory tests and x-rays are ordered on a weekly basis and include blood, urinalysis, chest x-ray, and EKG. As the patient begins to recover, skin grafting is usually performed by a surgeon.

Several changes in treatment philosophy have occurred since the Burn Treatment Center was opened. The treatment process has three components which may vary significantly according to the philosophy of a center's physicians:

- Debriding, or removal of burned skin
- Harvesting, or removal of live skin for later grafting
- Skin grafting

Originally, debriding was accomplished by a soaking technique, utilizing large hydro-tanks, and the surgical skin harvesting process was done in a surgical suite located in the Burn Treatment Center. Both of these procedures were spread over a fairly long period of time, and the repeated skin harvestings created the need for the surgical facilities located in the unit. Insofar as surgical facilities were available in the unit, they were also used for skin grafting.

Today, debriding is accomplished surgically, and both the debriding and skin harvesting are done in the hospital's Operating Rooms. Large areas of skin are now handled at one time during both the debriding and harvesting procedures, which improves infection control but also makes the procedures more physically traumatic for the patient. It is the latter factor which prompted the decision to begin performing the procedures in the hospital's surgical suite rather than in the BTC, as a general rather than a local anesthetic is now utilized in most cases. Skin grafting, a much less traumatic procedure than either debriding or harvesting, is now performed at the patient's bedside.

The ramifications of the above changes in approach are several. First, the surgical suite located in the BTC is no longer used, and while hydro-therapy is still employed, it is a much less integral

part of the treatment process. The increased emphasis on surgery performed outside of the department serves to shift the mix of costs as measured in this study from direct to indirect, and also to shift the mix of personnel from BTC nursing staff to both surgeons and Operating Room Department support staff. Further, the average length of stay in the BTC has decreased as a result of the debriding and harvesting being concentrated into fewer procedures over a shorter period of time. As such, a comparison of total cost per patient day as measured in this study (and analogously as measured for reimbursement purposes) with a similar figure before the change in procedures, would undoubtedly exhibit an artificially high rate of cost change.

The burn care is delivered by a multi-disciplinary team which is under the direction of a surgeon. The department's staff is composed of registered and licensed practical nurses, nurse aides/orderlies, a medical secretary and unit clerks in addition to the staff physicians (see Figure 10). Numerous physician specialists are available on call, including urologists, plastic surgeons, pediatricians, radiologists, internists, anesthesiologists, ophthalmologists, and psychiatrists.

Several other specialists, who are employees of other departments but have regular assignments in the Burn Treatment Center, contribute to the patient's rehabilitory process. These include physical and occupational therapists, social workers, and dieticians. Due to the significant physiological as well as psychological impact of a severe burn, counselling by a social worker for the patient and patient's family is essential to an effective treatment plan. Diet planning and monitoring is essential because the loss of epidermis causes low heat retention and thus rapid calory consumption.

The decision regarding patient discharge is based upon input from the entire Burn Treatment Center staff, and unless the bed is

Department Staff

- Physician Directors
- Registered Nurses
- Licensed Practical Nurses
- Nurse Technicians
- Aides/Orderlies
- Medical Secretary
- Unit Clerks

Diagnostic and Therapeutic Procedures

- Commonly Administered Tests
  - .. Blood (CBC, serum electrolytes, etc.)
  - .. Urinalysis
  - .. Chest X-ray
  - .. EKG

Major Equipment

- Circle-Electric Beds
- Burn Tank Units and Portable Hydro Tanks
- Radiant Warmers
- Respiratory Therapy Equipment
- Defibrillator
- EKG Machine
- Suction Equipment
- Cardiac Monitor

Special Cost Considerations

- Transportation of Patients
  - .. Helicopter
  - .. Ambulance
  - .. Communication System
- Social Work Counseling
  - .. Staff
  - .. Victim's Family
- Community Education About Burns
  - .. Newsletter and Movie
  - .. Tours of Unit
- Increase in ICU and med/surg volume - the majority of burn patients require follow-up inpatient care

FIGURE 10: BURN TREATMENT CENTER - INPUT LIST

urgently needed for a new patient, is dependent upon whether the patient can leave the hospital or be transferred to an ICU, medical-surgical unit, or rehabilitation center.

Measurement of Capital Expenditures

The space occupied by the Burn Treatment Center was originally a medical/surgical unit. The center includes a three bed open-space, comprehensive care section, several intensive care beds in partially walled rooms, and several private rooms. Considerable wall reconstruction was required for the former two bed areas as well as for a large therapy room.

The capital expenditures for the center in 1974 dollars, as well as the combined imputed/projected costs in 1977 dollars are listed in Figure 11. Only the building costs are imputed to estimate the cost of fully constructing the unit rather than renovating existing space. Because the surgical suite originally constructed in the unit is no longer in use, the cost of the major surgical equipment items (table, stools, lights, anesthesia machine, and 75 percent of the instruments cost) was excluded from the movable equipment expenditures, and space occupied by the operating room was excluded from the imputation of building costs for a fully constructed unit.

Type of Expenditure and Year	Expenditure Year Dollars	1977 Dollars
Building - 1974	$108,799[1/]	$849,866[2/]
Fixed Equipment - 1974	$161,240	$205,797
Movable Equipment - 1974	$125,197	$225,979
Total	$395,236	$1,281,642

1/ Cost for renovation of existing space

2/ Imputed cost for fully constructed unit

FIGURE 11 : BURN TREATMENT CENTER - CAPITAL EXPENDITURES

Volume of Service and Capacity

As summarized in Figure 12, the BTC has 15 beds and operated at 85 percent occupancy during the study period. Because the center must stand ready to receive patients directly from the site of injury as well as to accept patients transferred from another hospital shortly after their injuries, a significant bed contingency factor must be allowed to cover for fluctuating demand. Thus, the 85 percent average occupancy level is considered to be near the optimal level.

Admissions	173
Patient Days	4,650
Average Length of Stay	26.9
Average Daily Census	12.7
Beds	15
Occupancy Rate	84.9%

FIGURE 12 : BURN TREATMENT CENTER - VOLUME STATISTICS FOR JULY 1, 1976 THROUGH JUNE 30, 1977

The average length of stay during the study period was approximately 27 days, but it should be noted that there is considerable variance in length of stay according to the type of burn being treated.

Measurement of Direct Operating Costs

The components of direct cost for the Burn Treatment Center are summarized in Figure 13. The intern and resident program costs

Component of Direct Cost	Cost[1/]	Method of Calculation
Salary Cost	$625,176	As calculated in Figures 14 and 15
Intern-Resident Program	$ 77,804	Actual cost of program
Health and Welfare Benefits	$118,170	Hospital average percent of salary expenses (16.84%)
Depreciation:		Straight-line depreciation from 1977 dollar capital expenditures, using estimated life values of:
Building	$ 21,247	40 years
Fixed Equipment	$ 11,433	18 years
Movable Equipment	$ 25,109	9 years
Other Direct Costs	$303,827	Actual other direct costs
Total	$1,182,766	

1/ The direct cost figures reflect a $7,400 adjustment for costs incurred by allowing physicians to have private practices in the hospital. The adjustment was prorated across the salary, employee health and welfare, and other direct cost categories.

FIGURE 13 : BURN TREATMENT CENTER - DIRECT COSTS BY COMPONENT

include salaries for those assigned to the Burn Treatment Center as well as prorated salaries for instructors (excluding the BTC physicians, whose salaries are allocated entirely to patient care). The calculation of salary costs for the other departmental personnel is discussed in the paragraphs below, and the method of calculating the remaining components of direct cost is noted in the figure. The "other direct cost" category represents a relatively high percent of direct costs, primarily attributable to the fact that numerous medical supplies are ordered directly by the department rather than requisitioned through the Central Services Department (in which case such costs would be accounted for as indirect costs). These supplies include hydro-tank liners, intravenous solutions, ointments, dressings, etc. Other direct cost items are insurance, staff education and travel, and office supplies.

Figure 14 compares the planned and actual staffing for the BTC during the study period. In the physician category, the two full-time physicians employed by the center do not allow for the optimal two-shift coverage seven days per week, and a resident supplemented by on-call coverage must often be relied upon.

The discrepancy between the planned and actual non-physician staffing occurs almost entirely in the RN category, where 5.6 FTE nurses are available above the number required to fill the programmed 17 positions on a seven-day per week basis. However, management engineering studies generally make approximately a 12 percent allowance for vacation, sick, and holiday coverage, suggesting that an additional 5.8 FTEs are required to assure continual coverage of all programmed non-physician positions. Thus, the quantity of additional FTEs available for full vacation, sick, and holiday coverage at the study hospital is within normal guidelines, although it would theoretically be possible to spread the mix of additional coverage over the various nursing-related personnel classifications rather than concentrating it in the RN classification. Nevertheless, vacation, sick, and holiday coverage does explain the difference

PLANNED STAFFING PATTERN

Position	Day Shift Hours	Even. Shift Hours	Night Shift Hours	Total Shift Hours	FTE[1/] - 7-Day Coverage
Physician Directors	8	8	-	16	2.8
Head Nurse	8	-	-	8	1.0
RNs	64	48	24	136	23.8
LPNs	16	16	8	40	7.0
Nurse Technicians	8	-	-	8	1.4
Aides	24	16	-	40	7.0
Orderlies	8	8	-	16	2.8
Medical Secretary	8	-	-	8	1.0
Unit Clerks	16	8	-	24	4.8
Subtotal - Non-Physician	152	96	32	280	48.8
Total	160	104	32	296	51.6

ACTUAL STAFFING

Position	FTEs
Physician Directors	2.0
Head Nurse	1.0
RNs	29.4
LPNs	6.7
Nurse Technicians	1.3
Aides	7.0
Orderlies	3.0
Medical Secretary	1.0
Unit Clerks	4.0
Subtotal - Non-Physician	53.4
Total	55.4

[1/] FTE - 7-Day Coverage was calculated by multiplying total shift hours by seven and then dividing by forty (average hours worked per week).

FIGURE 14: BURN TREATMENT CENTER - COMPARISON OF PLANNED AND ACTUAL UTILIZATION OF PERSONNEL

between the planned and actual number of FTEs, such that actual personnel utilization can appropriately be used in the cost calculations shown in Figure 15.

This figure converts the actual staffing in FTEs to dollars, using average salary rates by personnel classification. The resultant total is compared to the salary cost appearing on the Medicare Cost Report, and the discrepancy between the two numbers is attributable primarily to the use of average salary rates rather than actual rates by individual.

Position	FTEs[1/]	Average Salary	Estimated Salary Cost FY 1977
Physician Directors	2.0	$45,000	$ 90,000
Head Nurse	1.0	$14,375	$ 14,375
RNs	29.4	$12,150	$357,210
LPNs	6.7	$ 9,900	$ 66,330
Nurse Technicians	1.3	$ 9,950	$ 12,935
Aides	7.0	$ 8,425	$ 58,975
Orderlies	3.0	$ 8,300	$ 24,900
Medical Secretary	1.0	$10,500	$ 10,500
Unit Clerks	4.0	$ 9,600	$ 38,400
Total	55.4		$673,625
Cost Report Total			$627,614

[1/] Full-time equivalents represent the actual staffing pattern as per Figure 14.

FIGURE 15: BURN TREATMENT CENTER - FULL-TIME EQUIVALENTS CONVERTED TO DOLLARS AND COMPARED TO COST REPORT FIGURE

In order to assess the generalizability of the above staffing data, comparison was made with a staffing pattern for the same average daily census using staffing ratios suggested by an extensive study of burn care programs and centers. As seen in Figure 16, the suggested staffing is significantly lower than that of the study hospital, with the difference concentrated in the RN classification. The difference between suggested and actual RN staffing is attributable in part to the implied use of RNs for vacation, sick, and holiday coverage, as discussed above, and also to a higher ratio of RNs to LPNs in developing the staffing patterns than the ratio suggested in the standards. Another significant factor affecting the RN as well as other staffing, however, is the stated policy of staffing the unit for 100 percent occupancy while its average occupancy is 85 percent. Some amount of contingency staffing is necessitated by the fact that nearly all of the patients treated by the center must be considered urgent if not emergent admissions, in contrast to the significant percentage of elective admissions handled by most medical/surgical units which are subject to scheduling control.

Measurement of Indirect Costs

The amounts allocated and bases of allocation for general and ancillary services are listed in Figure 17. The method of allocation of general services costs used for Medicare reporting was changed to more accurately distribute Utilization Review and Medical Records costs. The net effect of these two changes was to increase the BTC allocations by approximately $7,000. The following are comments specific to these and other general service allocations.

- Administration and General

  This cost is further broken down by the hospital into Utilization Review, Business Office & Patient Accounts, Purchasing & Storeroom, Admissions Office, and Other Administrative & General.

Position	Suggested Staffing Pattern (FTEs)[1/]	Study Hospital's Actual Staffing (FTEs)
Physician Director	1.0	1.0
Physician	.65	1.0
Subtotal - Physician	1.65	2.0
Head Nurse	1.0	1.0
RNs	15.9	29.4
LPNs	10.4	6.7
Aides/Orderlies	8.3	10.0
Subtotal - Non-Physician	35.6	47.1
Nurse Technicians	Not Available	1.3
Medical Secretary	Not Available	1.0
Unit Clerks	Not Available	4.0

[1/] P.C. Nutt, Ph.D., "Burn Care Standards," Wisconsin Medical Journal, Vol. 73, October, 1974, pg. 39. The author makes separate staffing recommendations for burn care centers (applicable to the study hospital), and burn care programs. The suggested staffing ratios were applied to the study unit's average daily census of 13 patients, and an allowance for vacation, sick, and holiday was added only for the nursing-related positions, as per the author's suggestion.

FIGURE 16: BURN TREATMENT CENTER - COMPARISON OF STUDY HOSPITAL STAFFING WITH SUGGESTED STAFFING PATTERN

.. Utilization Review

The Medicare Cost Report amount was calculated using inpatient revenue as the statistical base. However, it is more accurate to use number of admissions as the base of allocation, since the time devoted to review is not dependent upon patient charges.

.. Business Affairs and Patient Accounts

In contrast to Utilization Review, the amount of time spent by the Business Office personnel on a patient's account is highly dependent upon the number of charges. While number of charge slips might be the best base of allocation, the lack of such data necessitated use of patient charges, as per the Medicare Cost Report, which allocates a very large amount of Business Office costs ($30,193) to the Burn Treatment Center. The only alternative is to base the allocation on number of admissions, which incorrectly assumes that the time spent handling burn care patient accounts is the same as for medical/surgical patients.

.. Other Administrative and General

The support services included within this "catch-all" category are general to all patient care services (Personnel, Switchboard, Public Relations, etc.), and as such are allocated according to accumulated costs, as per normal Medicare Cost Report practice. However, the extreme costliness of burn care treatment in comparison to other inpatient units may result in Administrative and General costs being overstated using this base of allocation. Unfortunately, no suitable alternative base of allocation is available.

- Housekeeping

It is interesting to note that according to the hospital's estimated breakdown of housekeeping hours worked, more than six times as many hours per patient day are devoted to housekeeping in the Burn Treatment Center as on Adult and Pediatric Units (3.9 and 0.6 hours per day respectively). This is due to the fact that burn care patients are especially susceptible to infection, since many parts of their bodies are not covered by epidermis.

Cost Center	Cost Allocated	Base of Allocation
GENERAL SERVICE COSTS		
Administration & General		
* Utilization Review	$ 1,493	Number of admissions
Business Affairs & Patient Accounts	$ 30,193	Patient revenue
Purchasing & Storeroom	$ 19,369	Costed requisitions
Other	$ 88,393	Accumulated costs
Maintenance & Repairs	$ 32,477	Square feet
Operation of Plant		
Groundskeeping	$ 4,280	Square feet
Security	$ 19,832	Square feet
Medical Electronics	$ 3,983	Manhours
Other Operation of Plant	$ 69,945	Square feet
Laundry & Linen Service	$ 29,667	Pounds
Housekeeping	$163,888	Hours of service
Dietary	$ 76,490	Meals
Cafeteria	$ 14,846	FTEs (Burn Center Staff)
Nursing Administration	$ 70,864	Direct nursing hours of service
Central Services & Supply	$ 16,923	Costed requisitions
* Medical Records	$ 15,881	See explanatory notes
Social Service	$ 23,522	Time spent
Subtotal-General Service Costs	$682,046	

* These amounts allocated differ from the amounts indicated on the Medicare Cost Report: 1) The Cost Report allocated $6,202 to Utilization Review using inpatient revenue as the statistical base of allocation; 2) the Cost Report allocated $4,367 to Medical Records using admissions as the base of allocation.

FIGURE 17: BURN TREATMENT CENTER - INDIRECT COSTS

Cost Center	Cost Allocated	Base of Allocation
ANCILLARY SERVICE COSTS		
Operating Room	$ 42,209	Ratio-of-charges-to charges-applied-to-costs (RCCAC)
Recovery Room	$ 4,660	RCCAC
Anesthesiology	$ 5,045	RCCAC
Radiology-Diagnostic	$ 47,412	RCCAC
Radiology-Therapeutic	$ 309	RCCAC
Laboratory	$191,080	RCCAC
Blood Bank	$247,817	RCCAC
Intraveneous Therapy	$ 29,957	RCCAC
Inhalation Therapy	$110,761	RCCAC
Physical Medicine	$199,552	See explanatory note
Electrocardiology	$ 5,560	RCCAC
Electroencephalography	$ 2,234	RCCAC
Medical Supplies Charged to Patients	$ 78,638	RCCAC
Drugs Charged to Patients	$155,893	RCCAC
Subtotal-Ancillary Service Costs	$1,121,127	
Total-General & Ancillary Service Costs	$1,803,173	
OTHER RELATED SERVICES		
Helicopter & Associated Costs	$ 42,847	See explanatory note

FIGURE 17 : BURN TREATMENT CENTER - INDIRECT COSTS (Continued)

- Nursing Administration

  Nursing Administration includes in-service education, teaching, supervision, and general administrative duties.

- Medical Records

  The Medicare Cost Report's base of allocation for the Medical Records Department is number of admissions. However, hospital representatives estimated that the use of the Medical Records Department's time by burn patients is four times that of any other type of patient. The laboratory tests and other procedures that require charting far outnumber those given to any other type of patient. Accordingly, a base of "weighted admissions" was used; that is, the number of admissions to the Burn Treatment Center was multiplied by a factor of four before allocation of costs was made according to the number of admissions to each unit in the hospital. (The portion of Medical Records costs attributable to outpatient activity, as estimated by the hospital, was subtracted out before this allocation.)

With the exception of Physical Medicine, the cost of all ancillary services provided to burn care patients was calculated using the ratio-of-charges-to-charges-applied-to-cost method. The necessary charge data for an analysis specific to burn care was available from the hospital.

Unlike the other ancillary services, personnel from the Physical Medicine Department are permanently assigned to the Burn Treatment Center, and all of their work is performed on location in the center. For this reason, it was considered more accurate to estimate the cost of the specific personnel, rather than using the RCCAC formula. The Physical Medicine allocation is composed of the salaries and associated employee health and welfare costs of the physical therapists, technicians, and occupational therapists who work in the Burn Treatment Center as well as an estimated percentage of the amount of administrative and secretarial salaries and benefits, and other overhead costs which should be attributed to the Burn Treatment Center. This somewhat complex analysis is summarized below.

Physical Medicine Personnel Assigned to BTC

Personnel	FTEs	Salary Cost
Physical Therapists	2.2	$29,040
Occupational Therapists	.5	$ 6,775
Technicians	4.4	$40,040
	7.1	$75,855 + $12,774 = $88,629 (benefits at 16.84% of salaries)

Total Physical Medicine "Overhead" Personnel

Personnel	FTEs	Salary Cost
Physician	.4	$18,000
Supervisor	1.0	$17,000
Secretary	1.0	$10,000
		$45,000 + $7,578 = $52,578 (benefits at 16.84% of salaries)

Physical Medicine "Overhead" Personnel Attributable to BTC

$52,578	÷ 17	= $3,093	x 7.1	= $21,960
(from above)	(therapists and techs in Phy. Med., including those assigned to BTC)	(per FTE)	(FTEs assigned to BTC)	

Other Overhead Costs Attributable to BTC (non-salary direct costs and other support services allocated to Physical Medicine)

$213,010	÷ 17	= $12,530	x 7.1	= $88,963
	(FTE therapists and techs in Phy. Med.)		(FTEs assigned to BTC)	

$ 88,629 - personnel specific to BTC
$ 21,960 - overhead personnel
$ 88,963 - other overhead costs
$199,552 - total allocated to BTC

This amount compares to $185,718 allocated via the RCCAC formula. The implication (subject to measurement error) is that full-time placement of therapy personnel in the Burn Treatment Center is a more expensive, but necessary, approach to providing the service.

Expenses related to the hospital's helicopter transport service are related to the Burn Treatment Center, but cannot be considered direct or indirect costs according to the methodology of this study. Although the helicopter service is not utilized exclusively by the BTC, it probably would not exist if it were not for the Burn Center. The costs of this service are as follows:

Depreciation for helipad and related capital costs	$ 2,231
Depreciation for helicopter radio system	105
Contracted helicopter service	39,600
Plant Department salaries and fringe benefits	911
Total	$42,847

The salary expenses above relate to a team of three from the Plant Department that are responsible for assuring the safe landing and departure of the helicopter. It is estimated that each person spends one-half hour per helicopter trip, and there are approximately 35-40 such trips annually for burn care patients.

INPATIENT PSYCHIATRIC UNIT

Crozer-Chester Medical Center

An introduction to Crozer-Chester Medical Center was provided at the beginning of the Burn Treatment Center section of the report.

Acute Inpatient Psychiatric Care

The development of inpatient psychiatric units by general hospitals was the result of a belief that mental health services are among the services that should be available in the community and that many patients have needs that can best be treated outside of the long-term institutional setting (i.e., State psychiatric hospital). Inpatient psychiatric units operated by acute-care hospitals generally treat the patient who requires 30 days or less of close supervision by trained staff.

Acute inpatient care is one of the five originally required services of the 1963 Community Mental Health Centers Construction Act, although such units have been developed separate from community mental health centers. Since the unit at the study hospital is part of a community mental health center (CMHC), it is instructive to consider the particular attributes which set CMHCs apart from other mental health services.[1/]

- Specific Geographic responsibility - a CMHC must serve a catchment area of between 75,000 and 200,000 people (averaging about 150,000).
- Comprehensiveness - every center must provide at least five essential services to the catchment area served, including emergency services 24 hours per day, consultation and education programs, outpatient services, inpatient services, and partial hospitalization.
- Accessibility - the services must be accessible to all residents of the catchment area. This includes requirements that the people know of the services, that they be convenient, and that they be available regardless of ability to pay and without undue delay.

1/ S. Feldman and M.H. Goldstein, "Community Mental Health Centers in the U.S.A.: An Overview," from International Journal of Nursing Studies, Vol. 8, No. 4.

- Continuity of care - patients should move from service to service rapidly and smoothly as their needs dictate.
- Responsiveness to community needs - the community should be involved in the Center's planning and development so that the program may be relevant to the particular needs of the target population.
- A system of services - in many cases, the Centers are the result of affiliation between existing community agencies and hence have reduced the "fragmentation" of existing services.

Since the groundbreaking act in 1963, several amendments and extensions have taken affect. Among the changes are additional grant monies for staffing and specialized construction projects, and an expansion of the five basic required services to include special services for children, the elderly, and if not already available in the community, for alcoholics and drug abusers.

The Inpatient Psychiatric Unit at Crozer-Chester Medical Center

The CCMC Community Health Center was created in compliance with the overall plans of the CMHC legislation, and the Center offers 17 different services in 12 separate locations.

Catchment Area 234, Delaware County, Pennsylvania, is the primary service area of the CMHC as determined by Federal and State regulations. However, the specialized services offered by the CMHC are available to a larger geographic area with the intention of avoiding duplication of services.

The Inpatient Psychiatric Unit (IPU) was built in 1974 using grant monies and is located within the acute-care building of the medical center. The unit is designed and operated to provide an environment enabling the patients to live as close to normal life-styles as is possible given their psychological limitations. The unit provides an open therapeutic community with provision for patient input into the rules and regulations for daily living, and the staff are not uniformed. The patients have their own cafeteria and

a recreation room equipped with a television, ping-pong table, and a stereo.

The maximum length of stay in the unit per commitment is 30 days. While the average length of stay is undoubtely affected by insurance programs which limit reimbursement to fewer than 30 days per stay, it is not the policy of the unit to discharge, transfer or change the treatment mode of patients in response to this limitation.

As shown in Figure 18, patients are admitted into the psychiatric unit through five sources: walk-in, result of court hearing, crisis center (emergency room), referral by a physician, and referral from a hospital inpatient service. Prior to admission, the patients are screened at the Crisis Center by hospital psychiatrists. Patients diagnosed as having alcoholic problems, organic disorders, uncontrolled medical problems, or mental retardation are not admitted but are referred elsewhere. Following the screening process, a decision has to be made by the psychiatrists as to what type of admission is appropriate for the patient. Commitment can be either voluntary or involuntary. Seventy-five percent of inpatients voluntarily commit themselves and the majority of involuntary commitments are changed to voluntary status. Involuntary commitments are signed when a person is considered to be a danger to himself or others, and in turn can fall into either an emergency or non-emergency status. An emergent patient has an initial commitment time of 70 hours, while other involuntary admissions have a commitment period of 20 days.

Immediately following admission, the patient undergoes an intake interview with one of the psychiatric unit staff members and is then given a physical examination by the internist. The psychiatrist must establish an individual goal and treatment plan for the patient within 72 hours of admission. During these admission procedures, the patient's family is informed about the unit's policies and the treatment plan for the patient.

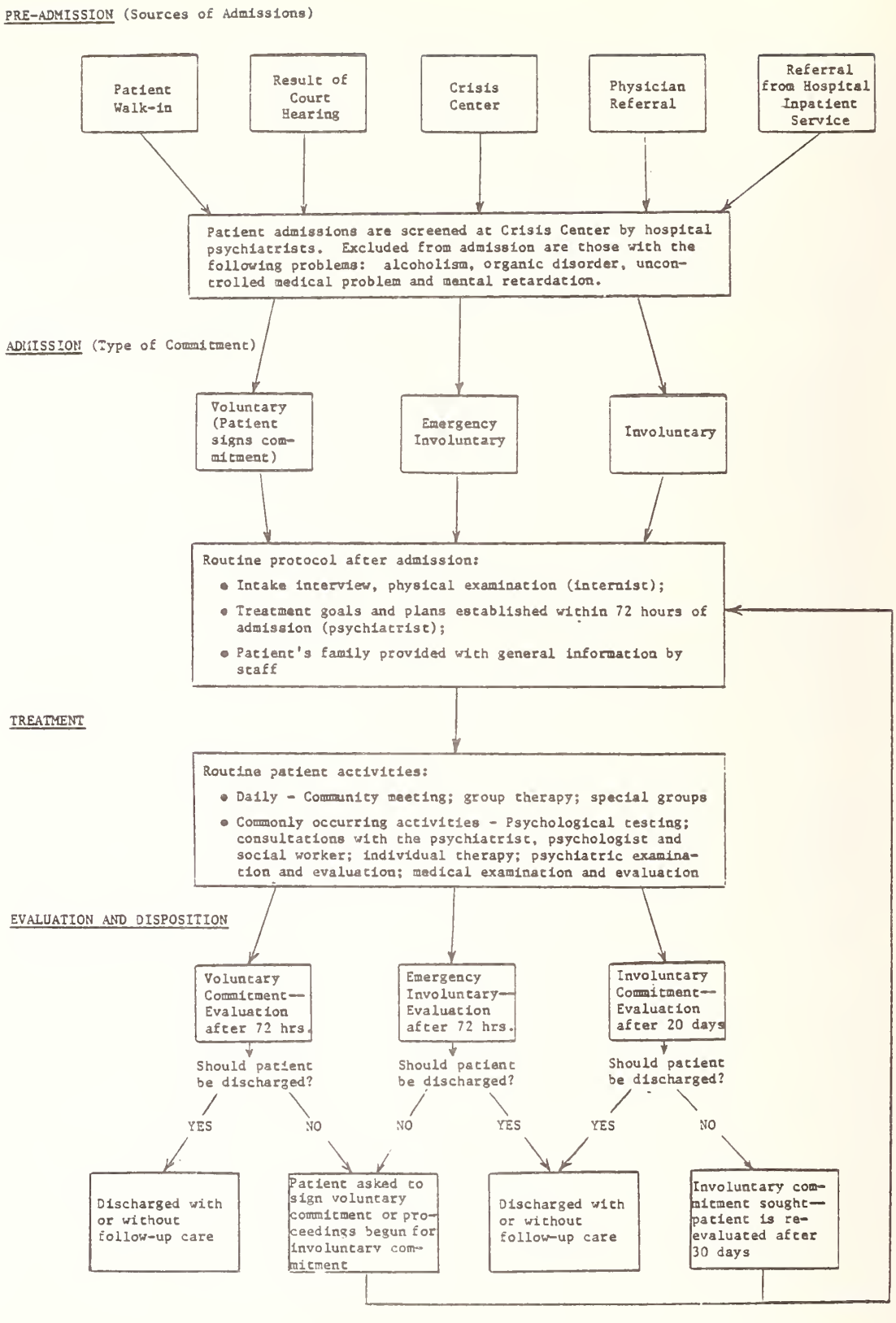


FIGURE 18: INPATIENT PSYCHIATRIC UNIT - EVENT-ORIENTED FLOW CHART

The patient's days are tightly scheduled and include therapeutic group meetings as well as psychological testing; individual therapy and evaluation sessions with a psychiatrist, psychologist, social worker or counselor; and medical examinations. Extensive use of the Laboratory and Pharmacy occurs in the unit. Tests commonly administered to aid in the diagnostic process are urinalysis, CBC, chest x-ray, and EEG. Tranquilizers, mood altering drugs, and placebos are given as part of the therapeutic process.

The evaluation and disposition protocols vary according to type of commitment. If a patient is voluntarily committed or committed under the emergency involuntary status and is determined to be unfit for discharge at the termination of the 72 hour period, he/she is asked to sign a voluntary commitment form. If the patient refuses to do so, proceedings for involuntary commitment are initiated. If a patient is committed in a non-emergent, involuntary status and is found to be unfit for discharge at the end of the 20 day commitment period, involuntary commitment is once again sought, and the patient will be re-evaluated at the end of thirty days. A recommitted patient must again undergo admission procedures of intake interview, physical examination and establishment of new treatment plans and goals.

As seen in Figure 19, the unit is staffed by psychiatrists, an internist, registered nurses, nurse technicians, three classes of non-physician personnel providing counseling, an art therapist, and secretarial personnel. Introduction of an Inpatient Psychiatric Unit causes significant tertiary cost impacts, which were not measured as part of this study, in the Emergency Room and Outpatient Psychiatric Departments. The majority of the IPU patients are initially examined in the Crisis Center, a component of the hospital's Emergency Room Department. Although the IPU is intended to serve patients with acute psychological problems, the majority of such patients have chronic needs as well, and virtually all patients

Department Staff

- Psychiatrists
- Psychologists
- Internist
- Registered Nurses
- Nurse Coordinator
- Nurse Technicians
- Social Workers (M.S.W.)
- Counselors (B.A.)
- Art Therapist
- Secretaries

Diagnostic and Therapeutic Procedures

- Commonly Administered Drugs
  - .. Tranquilizers
  - .. Mood Altering Drugs
  - .. Placebos
- Commonly Administered Tests
  - .. Urinalysis and CBC
  - .. Chest X-ray
  - .. EEG
- Medical Examination by Physician
- Initial Examination by Psychiatrist
- Psychological Testing
- Individual and Group Therapy Sessions

Facilities

- 14 Double Rooms
- 2 Single Rooms
- 3 Quiet or Isolation Rooms
- Conference/Library Room
- Cafeteria
- Recreation Room

Additional Cost Considerations

- Therapy Sessions for Patient's Family
- Significant impact upon the volume of Emergency Room (Crisis Center) and Outpatient Psychiatric Department as a result of patient admission and follow-up care

FIGURE 19: INPATIENT PSYCHIATRIC UNIT-INPUT FACTORS

are referred for outpatient care upon discharge from the unit. The intensity and length of follow-up care, however, varies considerably from patient to patient.

Measurement of Capital Expenditures

The Inpatient Psychiatric Unit was constructed on the second floor of a two-story project completed in 1974. The facilities include single rooms, double rooms, and "quiet" rooms for patient residence, plus activity and therapy rooms, exam rooms, a dining area, and supporting office and conference space. The total building costs for the construction project were allocated to the IPU on the basis of square footage, while the fixed and movable equipment costs are actual expenditures for items housed within the unit. The capital expenditures in 1974 and 1977 dollars are shown in Figure 20.

Type of Expenditure and Year	Expenditure Year Dollar	1977 Dollars
Building - 1974	$414,247	$528,719
Fixed Equipment - 1974	$ 65,882	$ 84,088
Movable Equipment - 1974	$ 88,436	$124,695
Total	$568,565	$737,502

FIGURE 20: INPATIENT PSYCHIATRIC UNIT - CAPITAL EXPENDITURES

Volume of Service and Capacity

As seen in Figure 21, the unit operates at almost 97 percent occupancy. Because the average length of stay is considerably longer than that of medical-surgical units (27 days in contrast to 8-10 days), greater scheduling control and hence a higher rate of occupancy is generally possible on such units. The 97 percent figure would be considered an optimal rate of utilization.

Admissions	454
Patient Days	9,871
Average Length of Stay	21.7
Average Daily Census	27.0
Beds	28
Occupancy Rate	96.6%

FIGURE 21: INPATIENT PSYCHIATRIC UNIT - VOLUME STATISTICS FOR JULY 1, 1976 THROUGH JUNE 30, 1977

Measurement of Direct Operating Costs

The IPU direct costs are summarized in Figure 23. The calculations of salary costs is the topic of the following paragraphs, while the method of calculating the other components of direct costs are listed in the figure. The category of "other direct costs" includes such items as insurance, temporary employees, general supplies, and staff education and travel. These costs comprise a very low percentage (4%) of direct costs.

Figure 22 exhibits the planned and actual staffing of the unit during the study period. The difference between planned and actual staffing is explained almost entirely by the slight shortage of RN personnel to fill the programmed eight positions on a seven-day per week basis. The missing RN position is usually absorbed on weekends, when the workload is lighter. Obviously, though, the planned staffing pattern provides the flexibility to operate with an RN or other position not filled, because the department does not have any extra staff to cover for vacations, sick leave, and holidays (other than occasional use of temporaries). Thus, the actual FTEs are believed to accurately represent the personnel requirements of the department, and actual rather than planned FTEs were used for the conversion to dollars in Figure 24. Average salary rates by personnel classification were used in this

PLANNED STAFFING PATTERN

Position	Day Shift Hours	Evening Shift Hours	Night Shift Hours	Total Shift Hours	FTEs[1] 7-Day Coverage
Psychiatrist	8	-	-	8	1.4
Psychiatrists (on-call)					
Psychologist	8	-	-	8	1.4
Internist[2]	2	-	-	2	.25
Subtotal	18	-	-	18	3.05
Head Nurse[2]	8	-	-	8	1.0
Nurse Coordinator[2]	8	-	-	8	1.0
Registered Nurses	24	24	16	64	11.2
Nurse Technicians	24	24	8	56	9.8
Social Workers (MSW)[2]	16	-	-	16	2.0
Counselors (BA)[2]	24	-	-	24	3.0
Art Therapist[2]	8	-	-	8	1.0
Secretaries[2]	24	8	-	32	4.0
Subtotal	136	56	24	216	33.0
Total	154	56	24	234	36.05

ACTUAL STAFFING

Position	FTEs
Psychiatrist	1.6
Psychiatrists (on-call)	
Psychologist	1.2
Internist	.25
Subtotal	3.05
Head Nurse	1.0
Nurse Coordinator	1.0
Registered Nurses	10.5
Nurse Technicians	10.0
Social Workers (MSW)	2.0
Counselors (BA)	3.0
Art Therapist	1.0
Secretaries	4.0
Subtotal	32.5
Total	35.55

[1] FTE-7 Day Coverage was calculated by multiplying total shift hours by seven and then dividing by 40 (average hours worked per week).

[2] The position is not replaced on weekends.

FIGURE 22: INPATIENT PSYCHIATRIC UNIT - COMPARISON OF PLANNED AND ACTUAL UTILIZATION OF PERSONNEL

Component of Direct Cost	Cost	Method of Calculation
Salary Cost	$ 547,410	As calculated in Figures 22 and 24
Health and Welfare Benefits	$ 92,555	Hospital average percent of salary expenses (16.84%)
Depreciation:		Straight-line depreciation from 1977 dollar capital expenditures, with useful life estimates of:
Building	$ 13,218	40 years
Fixed Equipment	$ 4,672	18 years
Movable Equipment	$ 13,855	9 years
Other Direct Costs	$ 25,114	Actual other direct costs
Total	$ 696,824	

FIGURE 23: INPATIENT PSYCHIATRIC UNIT - DIRECT COSTS BY COMPONENT

Position	FTEs[1/]	Average Salary	Estimated Salary Cost FY - 1977
Psychiatrist	1.6	$ 40,000	$ 64,000
Psychiatrists (on-call)			$ 50,000
Psychologist	1.2	$ 19,610	$ 23,532
Internist	.25	$ 40,000	$ 10,000
Head Nurse	1.0	$ 13,840	$ 13,840
Nurse Coordinator	1.0	$ 16,800	$ 16,800
Registered Nurses	10.5	$ 12,150	$127,575
Nurse Technicians	10.0	$ 9,100	$ 91,000
Social Workers (MSW)	2.0	$ 13,170	$ 26,340
Counselors (BA)	3.0	$ 11,480	$ 34,440
Art Therapist	1.0	$ 13,450	$ 13,450
Secretaries	4.0	$ 9,700	$ 38,800
Total	35.55		$509,777
Cost Report Total			$552,068

[1/] Full-time equivalents represent the actual utilization of personnel as per Figure 22.

FIGURE 24: INPATIENT PSYCHIATRIC UNIT - FULL-TIME EQUIVALENTS CONVERTED TO DOLLARS AND COMPARED TO COST REPORT FIGURE

calculation, and the use of averages rather than actual rates for the individuals involved explains the difference between the resultant total and the salary costs appearing on the Medicare Cost Report.

A literature search did not identify normative "suggested staffing" patterns or ratios comparable to those shown for several of the other service areas studied. The generalizability of the above personnel data was therefore assessed by comparing the study hospital's staffing levels to those of other comparably sized inpatient mental health facilities (see Figure 25). Although the study hospital has significantly higher than average staffing in the psychologist and social worker categories, the overall non-physician staffing (at least in those categories where comparison is possible) is only 5.3 percent above average.

Measurement of Indirect Costs

The bases of allocation and amounts allocated to the IPU from the various general service and ancillary departments of the hospital are exhibited in Figure 26.

Within the general service departments, the method of allocation used for Medicare reporting was changed for Utilization Review and Security to more accurately reflect the level of such services used by the unit. The net effect of the two changes was to increase the allocations to the IPU by approximately $14,900. The following are comments specific to these and other general service allocations.

- Administrative & General

  This cost center is further divided by the hospital into Utilization Review, Business Office & Patient Accounts, Purchasing & Storeroom, Psychiatric Administration, and Other Administrative & General.

  .. Utilization Review

     The Cost Report figure was calculated by using inpatient charges as the statistical base. However, it is more accurate to use the number of admissions as a base of allocation, since the time devoted to review is not highly correlated with the number and costliness of services rendered, and hence patient charges.

Position	Average Psychiatric Units' Staff (FTEs)[1]	Study Hospital's Actual Staffing
Psychiatrist	1.4	1.6
Psychologist	.4	1.2
Registered Nurses[2]	10.9	11.5
Social Workers	1.0	2.0
Paraprofessional Staff (Counselors & Nurse Technicians)	14.0	13.0
Subtotal - Non-Physician	26.3	27.7
Psychiatrist (on-call)	Not available	--
Internist	Not available	.25
Nurse Coordinator	Not available	1.0
Art Therapist	Not available	1.0
Secretaries	Not available	4.0

[1] C.A. Taube and M.J. Witkin, "Staff-Patient Ratios in Selected Inpatient Mental Health Facilities," Mental Health Statistical Note No. 129, May, 1976. The FTEs shown are based on hours worked per 100 residents in 207 non-public hospital psychiatric units with 25 to 49 beds. The published ratios were applied to the study hospital's average daily census of 27, and a 12 percent allowance was added for vacation, sick leave, and holiday coverage.

[2] The head nurse position of the study hospital is included in the registered nurse classification.

FIGURE 25: INPATIENT PSYCHIATRIC UNIT - COMPARISON OF STUDY HOSPITAL STAFFING WITH AVERAGE STAFFING OF INPATIENT PSYCHIATRIC SERVICES

Cost Center	Cost Allocated	Base of Allocation
GENERAL SERVICE COSTS		
Administration & General		
✸ Utilization Review	$ 3,918	Number of admissions
Business Affairs & Patient Accounts	$ 24,958	Patient revenue
Purchasing & Storeroom	$ 380	Costed requisitions
Psychiatric Administration	$176,417	Accumulated costs
Other Administration & General	$ 62,276	Accumulated costs
Maintenance & Repairs	$ 27,928	Square feet
Operation of Plant		
Groundskeeping	$ 3,680	Square feet
Security	$ 33,120	Weighted square feet See explanatory notes
Other Operation of Plant	$ 60,148	Square feet
Laundry & Linen Service	$ 10,854	Pounds of laundry
Housekeeping	$ 46,833	Hours of service
Dietary	$169,533	Meals
Cafeteria	$ 9,804	Full-time equivalents
Nursing Administration	$ 45,039	Direct nursing hours of service
Central Services & Supply	$ 184	Costed requisitions
Pharmacy	$ 31	Costed requisitions
Medical Records & Library	$ 11,508	Number of admissions
Subtotal - General Service Costs	$686,611	

✸ These costs differ from those indicated on the Medicare Cost Report:

- The cost report allocated $5,127 to Utilization Review, using charges as the base of allocation.
- The cost report allocated $17,054 to Security, using (unweighted) square feet as the base of allocation.

FIGURE 26: INPATIENT PSYCHIATRIC UNIT - INDIRECT COSTS

Cost Center	Cost Allocated	Base of Allocation
ANCILLARY SERVICE COSTS		
Radiology - Diagnostic	$ 6,233	Ratio-of-charges-to-charges-applied-to-costs (RCCAC)
Laboratory	$72,643	RCCAC
Electroencephalography	$13,384	RCCAC
Drugs Charged to Patients	$ 9,585	
Subtotal - Ancillary Service Costs	$101,845	
Total General & Ancillary Service Costs	$788,456	

FIGURE 26: INPATIENT PSYCHIATRIC UNIT - INDIRECT COSTS (Continued)

.. Business Affairs and Patient Accounts

In contrast to Utilization Review, the time required for processing accounts is probably related to the number and type of ancillary services charged, such that patient revenue (i.e., gross charges) rather than number of admissions is the appropriate base of allocation, as per the Medicare Cost Report.

.. Psychiatric Administration

Psychiatric Administration includes the salaries of the administrative staff who are dedicated entirely to psychiatric services (the hospital offers 17 psychiatric-related services) as well as other administrative expenses.

- Operation of Plant-Security

The hospital generally maintains a high level of security because of its city location and the fact that the layout of its plant (built circa 1900) is not amenable to monitoring by a small security force. While security officers were not assigned full time to the IPU, a sizable force is on duty, and the officers do spend a disproportionate amount of their time patrolling near both the IPU and the Crisis Center (Emergency Room) where the majority of the IPU patients are admitted, and also responding to calls from these areas. Accordingly, a factor of 2 was utilized in the allocation of Security costs by square footage; that is, IPU square footage was doubled before the allocation to all departments of the hospital on the basis of space occupied, such that the base of allocation could be viewed as "weighted square feet."

- Housekeeping

It is interesting to note that the Housekeeping Department devotes fewer hours per day to the Inpatient Psychiatric Unit (0.5 hours per day) than to the Adult and Pediatric Units (0.6 hours per day) due to the open-spaced layout of the department and the longer lengths of stay.

- Medical Records

Although psychiatric patients receive substantially fewer ancillary services requiring charting per day than do medical/surgical patients, their length of stay is generally three times as long (21.7 days and 7.5 days, respectively). Therefore, admissions is believed to be an appropriate base of allocation, as per the Medicare Cost Report.

- Pharmacy

  Only a very small amount of money is allocated from Pharmacy because virtually all drugs are charged to the patients (discussed under ancillary services below).

The RCCAC method was utilized for allocation of ancillary costs, but charge data specific to the Inpatient Psychiatric Unit were not available from the hospital and were therefore estimated using a random sampling of patient bills. First, the average charge per patient for those receiving service from a particular ancillary department was estimated, and then the percentage of patients receiving the service was determined. The process is illustrated below for Diagnostic Radiology.

> 350 (patients receiving chest x-rays, approximately 77 percent of IPU patients) x $20 (average IPU patient's charge for chest x-rays) = $7,000 ÷ $1,093,764 (total Radiology charges) = .0063 x $989,368 (total Radiology costs) = $6,233 (cost of IPU patients' use of Diagnostic Radiology).

The inputs for this analysis by ancillary department are as follows:

Department	Percent of Patients Using Service	Average Charge per Patient
Laboratory	100%	$300
Radiology-Diagnostic	77%	$ 20
EEG	50%	$ 70
Charged Drugs	100%	$150

LINEAR ACCELERATOR

Westmoreland Hospital

Westmoreland Hospital is a 366 bed private, non-profit institution located in Greensburg, Pennsylvania, in a county adjacent to Pittsburgh. Although a community hospital, Westmoreland maintains approved intern and residency programs, including a dental residency. The hospital has undergone significant growth and expansion of services over the last fifteen years, and now offers a wide scope of inpatient and outpatient services to the population of its city and county.

Radiation Therapy Utilizing a Linear Accelerator

Radiation therapy is the second most common form of treatment for cancer patients, with 50 percent of all cancer patients receiving radiation therapy at some point in the course of their treatment. Surgery is the most common form of treatment, and chemotherapy ranks third. The three modes of treatment may be used individually or in combination with each other.

Radiation therapy treats cancer patients with ionizing radiation, the goal being to deliver a lethal dose of radiation to the cancer cells without seriously damaging the surrounding normal cells.

External radiation therapy equipment falls into three general categories: superficial, orthovoltage, and megavoltage. Superficial machines are used to treat cancerous cells which are on and just beneath the skin, and thus the number of cancers which can be treated by this low-energy type of equipment is minimal. Orthovoltage machines do treat deep-seated tumors; however, their use has greatly diminished in recent years. Since the maximum radiation dose delivered by orthovoltage occurs at the skin surface, the dose which can be directed at the tumor is restricted by the skin's tolerance to radiation. With the introduction of megavoltage equipment in the mid-1950s, many of the problems linked with the orthovoltage machine were eliminated:

(1) The maximum dose of the megavoltage is underneath the skin's surface; therefore, the visible skin reaction is minor;

(2) Since the beam's margins are sharper than those of the orthovoltage machine, the dose of radiation inflicted upon nearby healthy cells is minimized;

(3) Megavoltage radiation has a greater rate of penetration and thus is able to send larger doses deeper into the body.

(4) With low energy radiation, bones tend to absorb more radiation than do soft tissues; however, high energy (megavoltage) radiation eliminates this pattern of differential absorption in the bone.

Megavoltage machines are more expensive than orthovoltage machines, attributable to both their higher purchase cost and the need for more expensive protection material in the treatment room. The linear accelerator and cobalt machine are the two primary types of megavoltage apparatus. While there are cost, machine reliability, and clinical performance differences between the two types of equipment, radiation oncology professionals have not arrived at a consensus regarding the preferred machinery.

The Linear Accelerator at Westmoreland Hospital

Although the Radiation Oncology Department at Westmoreland Hospital also maintains an orthovoltage machine, the vast majority of patients are treated with the linear accelerator. A limited number of cesium implants and radionuclide treatments are also provided. The department operates from 8:00 a.m. to 5:00 p.m., five days per week.

A radiation therapist is usually called in for a consultation while a cancer patient is still in the hospital following diagnosis (see Figure 27). At this time, previous x-rays are reviewed, the patient is examined (the therapist may travel to another hospital for the examination), and if radiation therapy is considered appropriate, a treatment plan is developed. There is generally a one week period between consultation and the initiation of treatment, during which time the dosage is calculated. Approximately 25 percent of the dosages are calculated with the aid of a computer which is located at another hospital and accessed via a terminal in the department.

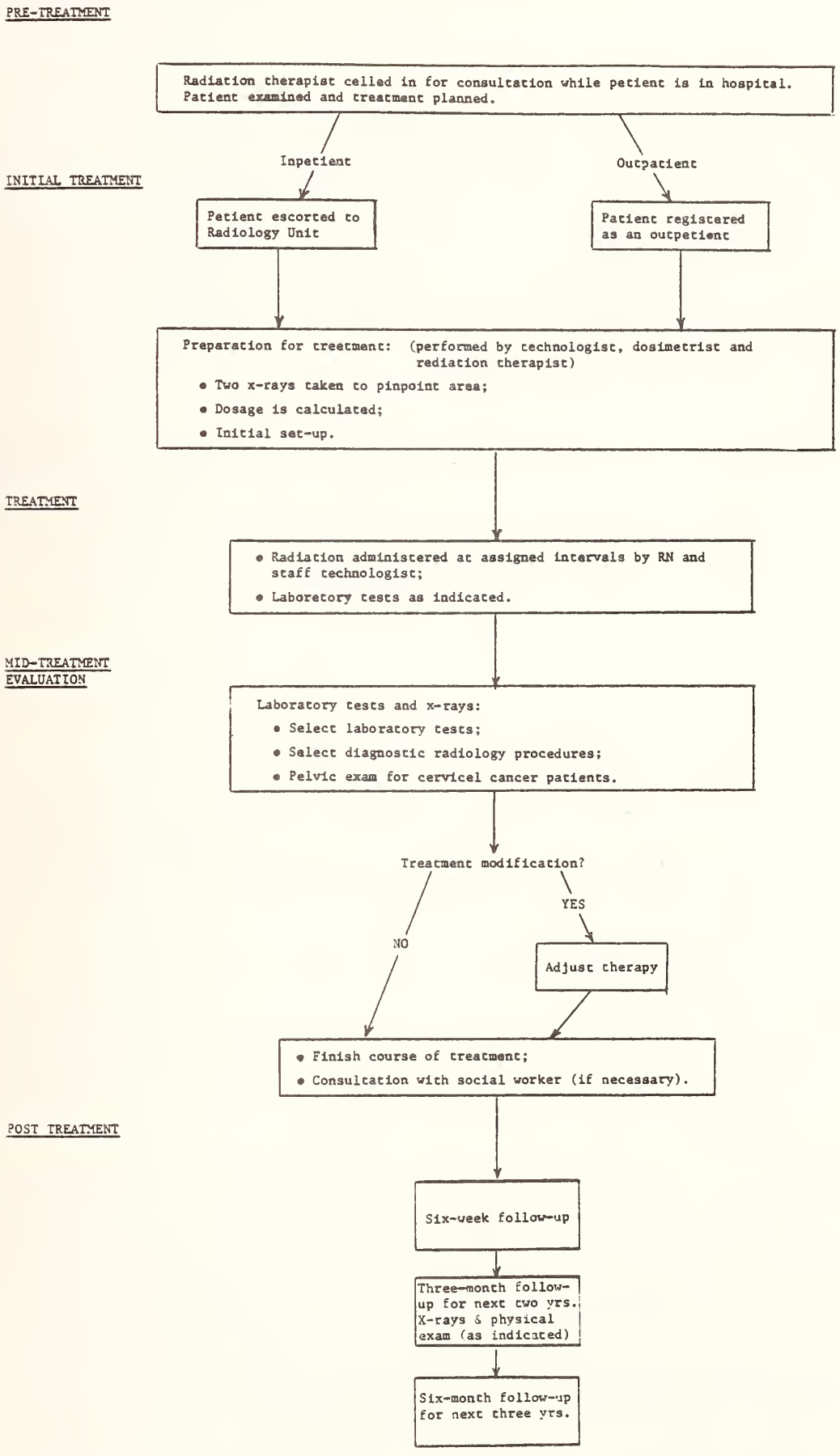


FIGURE 27: LINEAR ACCELERATOR - EVENT-ORIENTED FLOW CHART

Inpatients are brought to the department by an escort, while other patients register as outpatients and then proceed to the department. Prior to treatment on the first day, two x-rays must be taken with the linear accelerator to pinpoint the area requiring radiation, and this area is marked with ultra-violet ink. Initial set-up time is approximately 15 minutes for the majority of patients; however, patients with Hodgkins Disease require two set-up periods on successive days requiring 45 minutes each.

The average patient receives treatments five days per week for a five-week period, each treatment requiring approximately 10 minutes. The span of treatment, however, is dependent upon the type and size of the cancer as well as the side effects produced. The dosage is reassessed and often reduced at the midpoint of the treatment regimen.

A six-week follow-up visit is required for all linear accelerator patients, and follow-up visits scheduled from quarterly to annually are continued for a period of three years.

The radiation therapist orders laboratory tests and diagnostic x-rays prior to, during, and after the five-week treatment period. (The protocols of the Radiation Oncology Department for these procedures are listed later in this section.)

As summarized in Figure 28, the department is staffed with two physicians (one of whom is part-time), a physicist who acts as department manager, technologists (one of whom also performs dosimetry), a nurse who primarily assists the physicians in patient examinations, secretarial personnel, and a part-time escort.

One important cost consideration which is not reflected in the direct or indirect costs of the department is that the radiation therapy service is likely to increase the inpatient medical/surgical volume of patients. While patients are not admitted solely to receive such therapy, patients (or their physicians) often desire to obtain related services (surgery, palliative treatment when the patient is near death, etc.) at the same hospital.

Department Staff

- Radiation Therapists
- Physicist
- Chief Technician/Dosimetrist
- Staff Technologists
- Nurse
- Executive Secretary
- Clerk/Typist
- Receptionist
- Escort/Messenger

Diagnostic Procedures

- X-rays
  - .. Chest Patients - Chest x-ray
  - .. Brain Patients - ACTA Scan
  - .. Esophagus Patients - Barium Swallow
- Laboratory Tests
  - .. All Patients
    - CBC
    - Sedimentation
    - Hemoglobin
    - WBC
  - .. Bladder Patients
    - Urinalysis
- Special Examinations
  - .. Pelvic Patients - Pelvic Examination

Major Equipment

- Linear Accelerator
- TV Monitoring System
- Computer Terminal

Special Cost Considerations

- Computerized dosimetry (purchased from another hospital)
- Initial work-up and follow-up examinations by the department's physicians
- Probable increase in inpatient volume resulting from cancer patients desiring to obtain palliative or other follow-up treatment at the same institution.

FIGURE 28 : LINEAR ACCELERATOR - INPUT FACTORS

Measurement of Capital Expenditures

The construction of the Radiation Oncology Department was completed in three phases, resulting in the capital expenditures listed in Figure 29. While the department also housed the ortho-voltage machine, the need for construction of the present facilities was occasioned by the decision to purchase a linear accelerator.

A major construction project was completed in 1965, and this included laying the heavy concrete foundation for what was planned as an area for future expansion of the mechanical plant. The area was later found suitable for Radiation Oncology because of the existence of the heavy concrete, the fact that the space faced into earth on one side which reduced the need for further concrete walling, and because allowance had been made for 15 foot walls which were needed to house the linear accelerator. This area was 4.5 percent of the project by square feet, resulting in a cost estimate of $59,644 for building construction.

Type of Expenditure and Year	Expenditure Year Dollars	1977 Dollars
Building		
1965	$ 48,610	
1971	$ 20,375	
1974	$ 82,598	
Subtotal	$151,583	$253,011
Fixed Equipment - 1974	$ 53,933	$ 68,837
Movable Equipment - 1974	$152,601	$195,349
Total	$358,117	$517,197

FIGURE 29 : LINEAR ACCELERATOR - CAPITAL EXPENDITURES

The department is split between two buildings, the latter of which was constructed in several phases beginning in 1971. In the first phase, shell space and common areas, including an elevator, were constructed. An estimated $25,000 of this construction cost is attributable to the additional concrete needed for Radiation Oncology. The remainder is equitably distributed by square footage, of which Radiation Oncology accounted for $107,420. The second phase of this construction was completed in 1974 and involved filling in the shell space for the Radiation Oncology Department and another department. The construction and fixed equipment costs were allocated to Radiation Oncology on the basis of square footage, resulting in $101,347 and $66,176, respectively. The movable equipment, specific to the linear accelerator only, was also purchased in 1974 at a cost of $152,601.

The construction and fixed equipment costs are applicable to other Radiation Oncology services as well as to the linear accelerator, and, as such, these costs were allocated on the basis of square footage. The linear accelerator footage (81.5 percent of total) is the sum of the footage of the room housing the accelerator and a percent of the common space determined by the proportion of linear accelerator patients to total Radiation Oncology patients.

Building (1965)	$ 59,644 x .815 = $48,610
Building (1971)	$ 25,000 x .815 = $20,375
Building (1974)	$101,347 x .815 = $82,598
Fixed Equipment (1974)	$ 66,176 x .815 = $53,933

Volume of Service and Capacity

The 330 new patients treated via the linear accelerator during the study period (see Figure 30) represent 87 percent of the department's volume. Number of treatments is the most common volume measure for radiation therapy, although number of portals, or points of radiation entry, is sometimes used for a more exact accounting of staff time requirements. In most cases (spine patients are one prominent exception) two portals, front and rear, are involved in each treatment, and the "room time" for a two portal treatment is double that of a one portal treatment.

New Patients	330
Treatments	7,358
Average Treatments Per Day	28.3
Portals	14,080
Outpatients as Percent of Total	80-85%

FIGURE 30: LINEAR ACCELERATOR - VOLUME STATISTICS FOR JULY 1, 1976 THROUGH JUNE 30, 1977

Department personnel consider 40 treatments per day to be the maximum load that can be maintained on an ongoing basis with a one shift operation. Thus, at 28.3 treatments per day the department was operating somewhat below capacity during the study period, a factor which has a significant impact on the ratio of operating to capital expenditures. Further, the hours of operation could be expanded to Saturday and to more than nine hours per day during the week. While this approach would obviously minimize the cost per treatment in the short run, it must also be considered that the expanded utilization of the machine would shorten its life. The department's volume of linear accelerator patients is today approaching the 40 per day mark, and one alternative being considered is to purchase a cobalt machine to augment the clinical capabilities of the department, with the life of both machines projected over a longer time span. Another alternative utilized by larger radiation therapy departments is the purchase of a simulator which is used to relieve the burden of "set-ups" from the treatment machine. Such apparatus, however, costs nearly as much as a linear accelerator or cobalt machine, while not expanding the clinical capabilities of the department. From an internal or external

planning perspective, the definition of capacity and the appropriateness of further capital expenditures are complex issues.

Measurement of Direct Operating Costs

Direct costs by component for the linear accelerator are summarized in Figure 31. The calculation of salary expenditures is explained below, while the method of calculation for the other components are listed in the figure. The "other direct cost" category comprises only 10 percent of total direct costs and consists of such items as computer services for dosimetry, various supplies, and insurance.

Calculation of salary costs for the linear accelerator presented a methodological problem not encountered in any of the other service areas studied, in that virtually all of the personnel in the Radiation Oncology Department contribute to the treatment of both linear accelerator and other types of patients. It was therefore necessary to first establish the staff requirements of the department and then allocate the staff time (and corresponding salary cost) between linear accelerator services and other activities.

Figure 32 compares the planned and actual staffing of the department during the study period. The actual personhours shown in this figure consist of a standard 1.5 FTE for the physicians (their combination salary and fee method of payment is based on 1.5 FTE independent of actual hours worked), actual hours worked for the other departmental staff persons, and 0.5 FTE for a half-time escort/messenger who is carried on the payroll of the Physical Therapy Department. The discrepancy between the planned staffing pattern and the actual personhours is attributable to a decision during the year to replace a full-time clerk/typist who had left the department with a half-time person. The staffing pattern is therefore a closer representation of the personnel required to

Component of Direct Cost	Cost	Method of Calculation
Salary Cost	$167,180	As calculated in Figures 32 through 34
Health and Welfare Benefits	$ 13,029	Hospital average percent of salary expenses, excluding physicians (17.02%)
Depreciation:		Straight-line depreciation from 1977 dollar capital expenditures, with useful life estimates of:
Building	$ 6,325	40 years
Fixed Equipment	$ 3,824	18 years
Movable Equipment	$ 21,705	9 years
Other Direct Costs	$ 23,927	Allocation of actual other direct costs between linear accelerator and other patients based on percentage of patients
Total	$235,990	

FIGURE 31: LINEAR ACCELERATOR - DIRECT COSTS BY COMPONENT

PLANNED STAFFING PATTERN

Position	Day Shift Hours	FTEs - 5-day Coverage
Radiation Therapists (Physicians)	12	1.5
Physicist	8	1.0
Nurse	8	1.0
Dosimetrist	4	.5
Technologists	20	2.5
Receptionist/ Secretarial	20	2.5
Escort/Messenger	4	.5
Subtotal, Non-Physician	64	8.0
Total	76	9.5
Total with 1% overtime allowance[1/]		9.57

ACTUAL STAFFING

Position	FTEs
Radiation Therapists (Physicians)	1.50
Subtotal, Non-Physician	8.57
Total	10.07

[1/] The Radiation Oncology Department does not have additional staff available for vacation, sick, and holiday coverage, and the customary 12% allowance for such is thus inapplicable. However, overtime estimated at 1% of staff hours (other than salaried personnel) is utilized occasionally to cover for absences and periods of peak demand.

FIGURE 32 : COMPARISON OF PLANNED AND ACTUAL UTILIZATION OF PERSONNEL IN THE RADIATION ONCOLOGY DEPARTMENT

Position	FTEs[1]	Average Salary	Estimated Salary Cost - FY 1977
Radiation Therapists (Physicians)	1.50	$64,970	$ 97,455
Physicist	1.00	$21,668	$ 21,668
Nurse	1.01	$10,566	$ 10,672
Dosimetrist	.51	$12,095	$ 6,168
Technologists	2.52	$11,014	$ 27,755
Receptionist/ Secretarial	2.52	$ 8,650	$ 21,798
Escort/Messenger	.51	$ 6,630	$ 3,381
Total	9.57		$188,897
Cost Report Total			$186,566

[1] Full-time equivalents represent the planned staffing pattern as per Figure 32, with a 1% allowance for overtime added to the last five personnel categories.

FIGURE 33:. FULL-TIME EQUIVALENTS IN THE RADIATION ONCOLOGY DEPARTMENT CONVERTED TO DOLLARS AND COMPARED TO COST REPORT FIGURE

Position	Department Salary Cost	Percent Allocated to Linear Accelerator	Salary Cost Allocated to Linear Accelerator
Radiation Therapists (Physicians)	$97,455	93%	$90,633
Physicist	$21,668	60%	$13,001
Nurse	$10,672	90%	$ 9,605
Dosimetrist	$ 6,168	92%	$ 5,675
Technologists	$27,755	94%	$26,090
Receptionist/ Secretarial	$21,798	87%	$18,964
Escort/Messenger	$ 3,381	95%	$ 3,212
Total	$188,897		$167,180

FIGURE 34: ALLOCATION OF RADIATION ONCOLOGY SALARY COST BETWEEN LINEAR ACCELERATOR AND OTHER ACTIVITY

erate the department than the personnel utilized during the study riod, and the personhours resulting from the staffing pattern are ed in Figure 33 to convert hours to salary costs using average lary rates by personnel category.

The following details the methodology used for estimating the ercentage of the salary costs for each personnel classification o be allocated to operation of the linear accelerator (see Figure 4).

- Radiation Therapists

  As estimated by the department, 90 percent of the chief therapist's time and 100 percent of the half-time assistant therapist's time. The weighted average of these two individuals' times is 93 percent.

- Physicists

  By analyzing specific functions as summarized below, 60 percent of time.

Activity	Hours per Day	= (Percent of Time)	x (Percent of Time Allocated to Linear Accelerator)	= (Percent of Total Time to Linear Accelerator)
Radiation Safety Officer	.5	6.4%	20%	1.3%
Dosimitry	3.0	38.7%	80%	31.0%
Calibration	1.0	12.9%	60%	7.7%
Brachy Therapy	.5	6.4%	-	-
Supervision	.5	6.4%	87%*	4.4%
Repairs	.25	3.2%	90%	2.9%
Development	.5	6.4%	-	-
Continuing Education	1.0	12.9%	50%	6.5%
Treatment	.5	6.4%	100%	6.4%
	7.75	99.7%		60.2%

* Percentage of patients (linear accelerator, orthovoltage, others)

- Nurse
  - .. Time spent on cesium implants subtracted out; 19 implants in FY 1977 X 2 hours per implant = 38 hours
  - .. Time spent on radionuclide treatments subtracted out; 14 treatments in FY 1977 x 0.5 hours per treatment = 7 hours
  - .. The remaining hours for the year allocated between orthovoltage and linear accelerator activity by percentage of patients = 92 percent.

.. Netting the above result in a 90 percent time estimate

- Dosimetrist

  Time allocated between linear accerator and orthovoltage activity (both types of radiation therapy require similar dosage calculations) based on percentage of patients = 92 percent.

- Technologists

  Time allocated between linear accelerator and orthovoltage activity by percentage of portals = 94 percent.

- Receptionist/Secretarial

  Time allocated among linear accelerator, orthovoltage, and other types of patients based on percentage of patients = 87 percent.

In order to assess the generalizability of the above staffing data, comparison was made between the study hospital staffing for the linear accelerator and that suggested by a study commissioned by the Bureau of Health Planning and Resources Development, DHEW, to assist planning agencies. The Department obviously has greater flexibility in staffing by virtue of providing other types of cancer therapy than the linear accelerator treatments. This fact may partially explain the ability of the department to operate favorably in comparison with the suggested staffing (see Figure 35). The only personnel classification for which the suggested and study hospital staffing differs substantially is the dosimetrist. This difference is explained by two factors: (1) the physicist aids in dosimetry as one of his numerous activities, and (2) computerized dosimetry services are obtained.

Measurement of Indirect Costs

The fact that the operation of the linear accelerator is not a department in the hospital or a cost center for Medicare reporting dictated the need for a two-step process for allocation of general service costs: allocation to the Radiation Oncology Department and then to the linear accelerator. The base of allocation used for distribution of general service costs on the Medicare Cost Report

Position	Suggested Staffing Ratios[1]	Linear Accelerator Volume	Suggested Staffing at Volume (FTEs)[2]	Study Hospital Staffing for Linear Accelerator (FTEs)
Radiation Therapists (physicians)	one per 150-250 new patients annually	330 new patients per year	1.6	1.4
Physicist	one per 400 new patients annually	330 new patients per year	.8	.6
Nurse	one per 300-400 new patients annually	330 new patients per year	.9	.9
Technologists	one per 15-20 patients under daily treatment	28.3 treatments per day	1.6	2.3
Dosimetrist (and other treatment planning personnel)	one per 200 new patients per year	330 new patients	1.6	.5
Subtotal - Non-physician			4.9	4.3
Receptionist/Secretarial	not available	---	---	2.2
Escort/Messenger	not available	---	---	.5

[1] C.H. Baker, Criteria and Standards for Radiation Therapy Services, Department of Health Services, University of Washington, under DHEW Contract No. HRA 106-74-56, December 1975, pg. 64-74.

[2] Computed using the midpoint of the ratios in column 2.

FIGURE 35: COMPARISON OF LINEAR ACCELERATOR STAFFING WITH SUGGESTED STAFFING RATIOS FOR RADIATION THERAPY SERVICES

was changed in several cases, as noted in Figure 36 and discussed by service below. In the majority of cases, the percentage of new patients in the department treated with the linear accelerator (87 percent) was used as the base for the second level of allocation, and exceptions to this approach are also noted in the discussion below.

- Data Processing

  The Radiation Oncology department does not utilize the hospital's data processing services for patient care applications (computerized dosimetry is obtained by contract from another hospital, as discussed under direct costs). Data Processing is allocated according to several statistical bases by type of service (payroll management reports, etc.), and the amount allocated to Radiation Oncology is $160. While this figure is small, it should be noted that the majority of costs are allocated to Accounts Receivable, Cashiering, and Collections, which in turn has its costs allocated to patient care departments.

- Admitting Department

  Admitting costs are allocated according to inpatient charges, such that all ancillary departments serving inpatients will be charged a share of such costs. Because inpatients are never admitted solely for the purpose of receiving radiation therapy, this cost might be conceptualized as inapplicable to Radiation Oncology. Although either method could be considered correct, the cost ($344) was deleted for purposes of this cost analysis.

- Cashiering, Accounts Receivable, Collections

  .. This cost center includes two hospital departments: Accounts Receivable (often termed the Business Office) and Credit and Collections. The costs are allocated according to gross patient charges. However, in the case of Accounts Receivable, the function differs significantly according to the inpatient/outpatient status of the patient. Radiation Oncology is considered not to utilize the service for inpatients because the patients are not admitted solely for the purpose of receiving radiation therapy. However, outpatient Accounts Receivable incorporates outpatient registration which is heavily utilized by the department. Every outpatient receiving radiation therapy treatment must register initially and also "check-in," including obtaining a charge slip, before each treat-

Cost Center	Cost Allocated	Base of Allocation	
		To Radiation Oncology Dept.	To Linear Accelerator
GENERAL SERVICE COST CENTER			
Non-Patient Telephone	$ 2,688	Telephones	New patients
Data Processing	$ 139	Various	New patients
Purchasing	$ 354	Non-salary costs	New patients
* Admitting	N/A		
Cashiering, Accounts Receivable, Collections			
* Accounts Receivable Outpatient	$ 8,155		Outpatient visits
Credit and Collections	$ 1,324	Total charges	New patients
Administration & General			
* Social Services	$ 4,819	Approximated hours of service	New patients
Utilization Review	N/A		
Volunteers	N/A		
Bond Interest	N/A		
Other Administration & General	$12,333	Accumulated cost	New patients
* Plant Engineering	$15,104	Square feet & hours worked	Square feet & hours worked
Laundry & Linen Service	$ 1,476	Pounds	New patients

*In most cases, the general service and ancillary costs were allocated using a two-step process: allocation to the Radiation Oncology Department (a cost center on the Medicare Cost Report), then allocation to the linear accelerator. The asterisks connote a change in the base of allocation for Radiation Oncology from that used for Medicare reporting.

FIGURE 36 : LINEAR ACCELERATOR - INDIRECT COSTS

Cost Center	Cost Allocated	Base of Allocation	
		To Radiation Oncology Dept.	To Linear Accelerator
Housekeeping	$10,044	Hours worked	Square feet
Dietary	N/A		
Cafeteria	$ 840	Employees	Employees
Nursing Administration	N/A		
✱ Central Services & Supply	$ 800		Imputed
Pharmacy	$ 87	Costed Requisitions	New patients
Medical Records	N/A		
Patient Telephone	N/A		
✱ Escort Service	$ 1,396	Hours worked	Hours worked
Subtotal-General Service Costs	$59,559		
ANCILLARY SERVICES			
✱ Laboratory	$ 6,756		Systems approach-see notes
✱ Radiology-Diagnostic	$14,271		Systems approach-see notes
✱ Medical Supplies Charged to Patients	$ 300		Imputed
✱ Drugs Charged to Patients	$ 300		Imputed
Subtotal-Ancillary Service Costs	$21,627		
Total General & Ancillary Service Costs	$81,186		

FIGURE 36: LINEAR ACCELERATOR - INDIRECT COSTS (Continued)

ment. As such, the allocation scheme was modified to segregate outpatient Accounts Receivable costs, which were allocated directly to the linear accelerator using outpatient visits as the base of allocation (linear accelerator treatments are counted as visits in the total). It is important to note that the use of visits as the base of allocation assumes that the time required to process a linear accelerator patient is the same as that required for any other outpatient. Using outpatient charges, on the other hand, would have overallocated accounts receivable costs, because a linear accelerator treatment is far costlier (and correspondingly carries a higher charge) than average outpatient visits. Using the "visit" allocation resulted in $8,155, and using the "charges" allocation would have resulted in $26,065.

.. Credit and Collections are segregated out, as described above, but the costs are allocated according to total charges as per the Medicare Cost Report.

- Other Administration and General

.. These costs encompass numerous hospital departments. Using data from the hospital's internal accounting system, several components of "Other Administration and General" were analyzed separately.

.. Social Service

The Radiation Therapy Department provided the estimate of 25 patients per year receiving social service, such that the percentage of Social Service costs applicable to Radiation Oncology would theoretically be estimated by use of the percentage which 25 represents of the annual Social Service workload. However, the total number of patients in the hospital provided social service could not be determined. As such, these costs were allocated to all patient care departments which the project staff believe are likely to receive social service according to an "approximate hours of service" allocation.

.. Utilization Review

These costs are appropriately allocated entirely to inpatient services according to patient charges. The Radiation Oncology Department is not reviewed.

.. Volunteers

These services (according to a statement by the hospital) are utilized entirely by the inpatient service departments and the operating rooms, and as such, no cost was allocated to Radiation Oncology.

.. Bond Interest

Because the bonds in question were issued in connection with the development of another patient service, no cost was allocated to Radiation Oncology.

.. Other

The remaining ten accounts within Other Administration and General are all general in nature (e.g., public relations, planning), and are therefore appropriately allocated according to accumulated costs as per the Medicare Cost Report.

- Plant Engineering (maintenance and repairs, operation of plant)

Radiation Oncology receives normal maintenance services and utilizes an average amount of utilities on a square footage basis, and as such, the current allocation of such costs based on square feet should be accurate. However, the linear accelerator requires a technician to start the machine daily, and the person also performs some maintenance functions on the machine. Approximately one-half hour per day, or 0.125 FTE, is required to perform this service, a cost which was allocated to Radiation Oncology in addition to the amount as above ($11,442 salary x 0.125 = $1430 taken out of maintenance total before allocation, then added back to Radiation Oncology after allocation). This resulted in $18,208 for Radiation Oncology in contrast to $17,004 as per the cost report. This amount was then allocated to the linear accelerator based on percent of square footage occupied (81.5%) with the cost of the technician referenced above allocated entirely to the linear accelerator.

- Housekeeping

The same 81.5 percent of space occupied as used for Plant Engineering above was used to allocate Housekeeping costs to the linear accelerator (the second level of allocation). Usage of both of these services are related more closely to space considerations than to patient load served.

- Central Services

This service consists of three components: (1) distribution of non-chargeable supplies, of which Radiation Oncology utilizes a very minor amount, (2) processing, usually involving sterilization as well as distribution of reuseable supplies, and (3) distribution of chargeable supplies, which is considered an ancillary service and will be discussed later in this section. The department periodically utilizes sterilization services for instruments utilized to examine linear accelerator patients, particularly gynecological patients. The commonly used base of allocation

for Medicare, costed requisitions for non-chargeable supplies, in effect does not recognize this service. Because data were not available to accurately measure the service, an imputed value of $800 was used in place of the $15 shown on the cost report.

- Escort Service

  Although Radiation Oncology utilizes its own escort to bring inpatients to the Department and return them to their rooms, the Escort Service (organized within Adult and Pediatrics) is utilized to provide a second person to assist with most patients who are transported on carts. It is estimated that approximately two hours per day of such service is utilized. From the hospital's records, it was found that two hours per day represents 5 percent of escort man hours x $29,388 total salary and non-salary cost of Escort Service = $1,469. As estimated by the department, 95 percent of this escort service is attributable to the linear accelerator.

The normal cost accounting method of estimating the ancillary service costs incurred as the result of operating a linear accelerator would be the ratio-of-charges-to-charges-applied-to-costs. However, not all of the costs of ancillary services provided to cancer patients whose primary mode of treatment is radiation therapy can be attributed to the Radiation Oncology Department. Only those procedures that are a necessary part of the protocol for treatment via the linear accelerator should be so allocated.

The measurement approach which was used was to obtain the departmental protocols for ordering laboratory and diagnostic radiology procedures and apply the cost of each procedure to the appropriate volume statistics. The protocols are as follows:

- Laboratory
  - .. All patients receive a CBC at first treatment - cost one CBC per patient.
  - .. An average of 80 percent of all patients receives a sedimentation rate at first treatment, and half of these receive a follow-up sedimentation rate halfway through the regimen - cost 1.2 sedimentation rates per patient.

- .. One hemoglobin and one WBC are provided on a weekly basis for all patients, with the average treatment regimen lasting five weeks - cost 5 hemoglobins and 5 WBCs per patient.
- .. Bladder patients receive approximately 4 urinalyses over the course of their treatment - cost 4 urinalyses per bladder patient.

- Radiology

  .. Chest x-rays are given to all chest/lung patients as follows:

  -- half-way through treatment (1)

  -- end of treatment (1)

  -- six weeks after end of treatment (1)

  -- every three months for two years (8)

  -- every six months for three years (6)

  This totals to 17 x-rays. Since patients often leave the area, die or initiate treatment again, the assumption is made that only one of the last three years of x-rays is applicable - thus, 13 x-rays are costed per patient. The department has been in operation for approximately three years; therefore, the follow-up exam load does reflect patients in their first, second, and third year of follow-up.

  .. Each brain patient receives an ACTA scan (computerized tomography) after six months - cost one scan per patient.

  .. Each esophagus patient receives one barium swallow half-way through treatment - cost one barium swallow per patient.

The cost of each of the ten types of procedures above was estimated by applying the aggregate ratio of costs to charges for laboratory or radiology to the charge or price for the applicable procedures. The following calculations for chest x-rays and hemoglobins illustrates the process.

Chest x-rays

chest patients	x	procedures per patient	x	charge per procedure	x	ratio of costs to charge	=	cost for all chest x-rays
95	x	13	x	$14.10	x	.75	=	$13,060

Hemoglobins

new patients	x	tests per patient	x	5% error and repeat rate	x	charge	x	ratio of costs to charges	=	cost for all hemoglobins
330	x	5	x	1.05	x	$2.25	x	.52	=	$2,027

There are no comparable protocols for chargeable drugs and supplies, and neither is used extensively in the course of treatment via the linear accelerator. An imputed value of $300 was used for each of these costs.

RENAL DIALYSIS UNITS

Sutter Community Hospitals of Sacramento

Sutter General and Sutter Memorial Hospitals are the two private, non-profit institutions which comprise the Sutter Community Hospitals of Sacramento, California. Sutter General was opened in 1923, and Sutter Memorial was established as a satellite maternity hospital in the 1930s. Today, both institutions are full-service hospitals of 280 and 378 beds, respectively, with the top administrative group and several patient care services being shared. Although not serving as the primary teaching facility of a medical school, the hospitals maintain an approved residency program, and a wide scope of inpatient and outpatient services are provided for residents of the greater Sacramento area.

Renal Dialysis

Renal dialysis becomes necessary when a patient is diagnosed as having end stage renal disease (ESRD), a condition occurring when kidney function is reduced to only five percent of normal function. The only alternative to dialysis for a victim is kidney transplantation. ESRD can be either chronic or acute. A chronic victim is one whose kidneys have deteriorated over a long period of time, and kidney function is never regained. The acute victim, on the other hand, experiences a rapid cessation of kidney function, and unlike the chronic victim, the acute victim's kidney functioning is generally restored within a few weeks.

Hemodialysis is a technique which uses an artificial kidney machine to extract fluids and metabolic end products from the bloodstream. Blood is taken through a needle from a blood vessel in the arm and is carried to the artificial kidney hemodialysis machine. The blood is cleaned in the machine during the process of diffusion, osmosis, and ultrafiltration, and is then returned to the body.

Vascular surgery must be performed prior to dialysis treatment in order to create an access point in the patient's arm. Access can be obtained through an internal fistula or external shunt, both

involving the connection of an artery and a vein, or a temporary access point for acute patients can be formed by grafting a vein into the arm.

Under the 1972 Amendments to the Social Security Act, almost every ESRD victim is entitled to Medicare coverage for dialysis or transplantation. ESRD is the only catastrophic illness for which Medicare provides universal coverage, and the program is often viewed as a forerunner to national health insurance.

The most controversial issue in the renal dialysis field is that of home dialysis. There is a definite split in opinion among nephrologists--one side believing that professional supervision is necessary at all times while the patient is undergoing dialysis, and the other confident that a properly trained patient and "helper," usually a spouse, are capable of hamdling the dialysis process. Even though some nephrologists strongly advocate home dialysis, there are presently few patients who do dialyze at home. There are many problems associated with this approach: a trained helper must be continuously available, special plumbing must be installed in the house, and many fear an adverse psychological impact upon children. Further, because full reimbursement is available for treatment in an institution, there is no incentive for the patient to dialyze at home if he finds this approach less convenient, and no incentive for professionals in the field to encourage the patient to do so.

The Standard and Limited Care Renal Dialysis Units at Sutter Community Hospitals

Sutter Community Hospitals have two types of dialysis units--Sutter Memorial operating a 13-station Standard Unit (6 days a week, 2 shifts per day) and Sutter General operating a 12 station Limited Care or Self Care Unit (6 days a week, one shift per day). The Standard Unit delivers treatment to acute patients and to the more severe of chronic patients under the close supervision of staff. The Limited Care or Self Care Unit serves the less severe chronic patients, and the patients assume a much more active role in the operation and

monitoring of the dialysis equipment. Training for home dialysis patients is also provided in the Limited Care Unit. As exhibited in the flow diagram of Figure 37, most patients progress from the Standard to the Limited Care Unit, and all patients are assessed for home care, although relatively few adopt this course of treatment.

As mentioned previously, all patients accepted for renal dialysis must first have vascular access surgery. In the vast majority of cases, chronic disease patients are then dialyzed on an outpatient basis three times per week. Acute care patients, who are generally inpatients in the hospital, are brought to the dialysis unit if they are capable of being moved, or a portable dialysis machine can be brought to the patient's room by a dialysis nurse.

Upon entering the unit for dialysis, every patient is weighed in and has the vascular access area anethesized. A nurse then hooks up the patient to the dialysis machine, blood pressure is checked throughout the dialysis process, and the patient is weighed again after the approximately six-hour treatment is completed. Laboratory tests (e.g., potassium, blood sugar, chemistry panel for hepatitis), EKGs, and x-rays (chest x-ray and metabolic bone survey) are given as necessary. Occupational and recreational therapy together with counseling from a social worker are an important part of the treatment regimen, because the patient must learn to "live with" the time-consuming and often discomforting dialysis process indefinitely. Dietetic counseling is also provided regularly.

As summarized in Figure 38, the dialysis units are staffed with a nephrologist, nurse coordinator, and head nurse, all of whom are shared between the units. In addition, there are several registered nurses, licensed vocational nurses (equivalent to licensed practical nurses), technicians, and a clerk in the units. The nephrologist is employed by the hospital 12 hours per week to provide medical direction and also treats patients privately. The coordinator performs the administrative functions of personnel supervision, program planning and budgeting, and also is responsible for staff training with the assistance of one of the department's RNs.

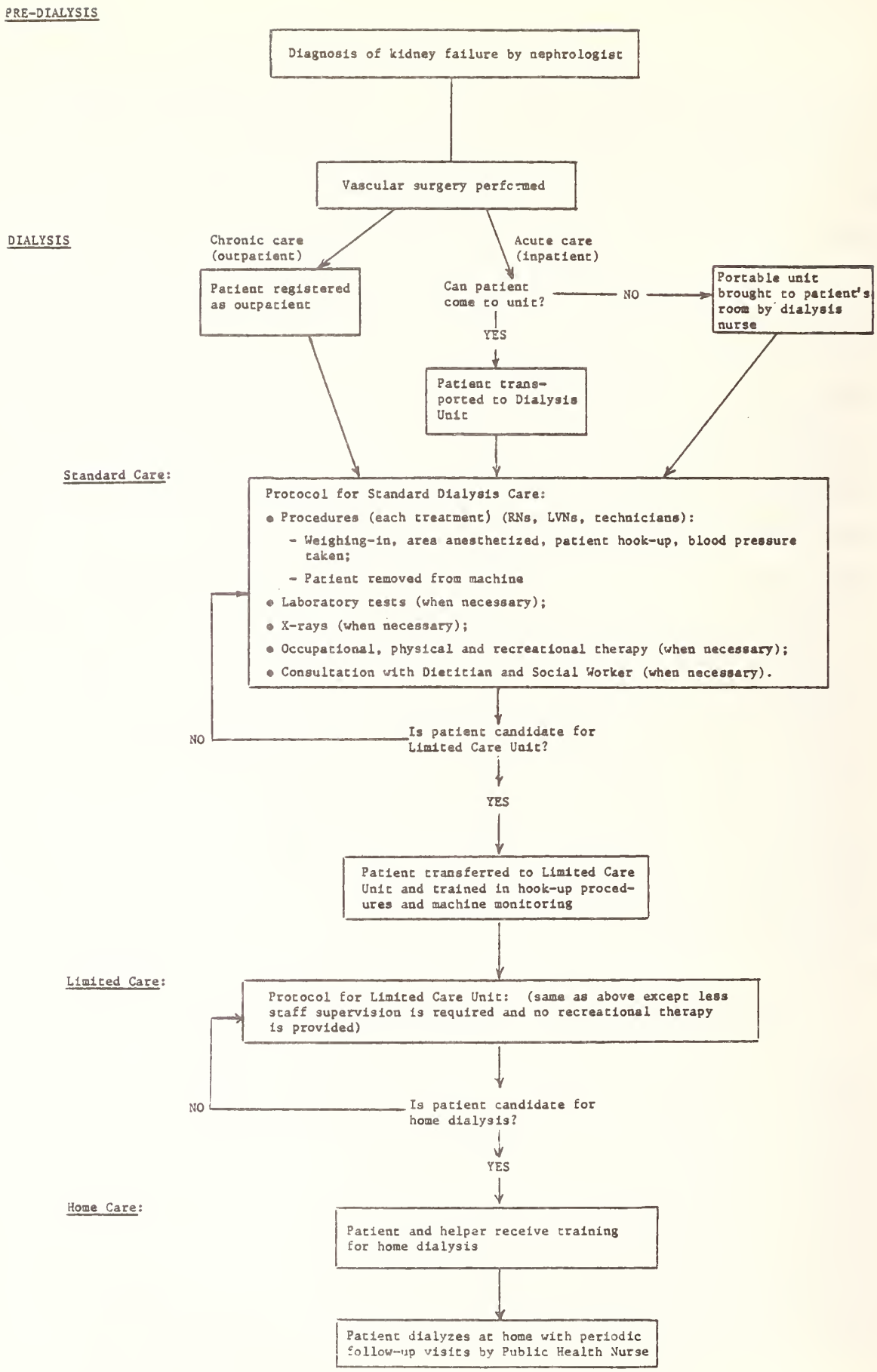


FIGURE 37: RENAL DIALYSIS - EVENT-ORIENTED FLOW CHART

Department Staff

- Nephrologist
- Registered Nurses
- Licensed Vocational Nurses (equivalent to LPNs)
- Technicians
- Unit Clerk

Diagnostic and Therapeutic Procedures

- Commonly Administered Drugs During Dialysis
  - .. Heparin
  - .. Protamine
  - .. Valium
  - .. Phosphate Binders
  - .. Blood Transfusions
  - .. Mannitol
- Drugs Taken Regularly While Off Dialysis
  - .. Folic Acid
  - .. Multiple Vitamins
  - .. Iron Preparation
  - .. Anabolic Steroids
  - .. Cathartics
  - .. Vitamin B_{12}
  - .. Vitamin D
  - .. Calcium
- Laboratory Tests
  - .. Potassium
  - .. Blood Sugar (for diabetics)
  - .. Chemistry Panel
- EKGs
- X-Rays
  - .. Chest X-Ray
  - .. Metabolic Bone Survey

FIGURE 38 : STANDARD AND LIMITED CARE RENAL DIALYSIS UNITS - INPUT FACTORS

Major Equipment

- Thirteen self-contained dialysis stations[1/]
- Twelve dialysis stations with central pumping system[2/]
- Three Portable Dialysis Machines
- Audiovisual Equipment[2/]
- Televisions
- Telephones for Patients[2/]

Special Cost Considerations

- Vascular Access Surgery[1/]
  - .. Graft
  - .. Internal Fistula
  - .. External Shunt
- Home Dialysis Training for Patients and Helper, Including Audiovisual[2/]
- Visits to Home Care Patients by Public Health Nurses
- Limited Care Training for Patient, Including Audiovisual[2/]
- Hepatitis Precautions
  - .. Testing Every Three Months - Patient and Staff
  - .. Isolation Room
- Training of Staff
  - .. Registered Nurses
  - .. Licensed Vocational Nurses
  - .. Technicians
  - .. Housekeepers

[1/] Applicable only to Standard Unit

[2/] Applicable only to Limited Care Unit

FIGURE 38: STANDARD AND LIMITED CARE RENAL DIALYSIS UNITS - INPUT FACTORS (Continued)

Although not included in the cost analysis for this study, the units also employ three public health nurses who train patients and their helpers for home care, and visit the home care patients bi-monthly to assess the dialysis setting from both a psychological and physical health standpoint. A part-time audio-visual specialist was formerly employed to prepare instructional films for limited care and home dialysis patients.

One unique cost consideration for renal dialysis is the need for extensive hepatitis precautions. All staff and patients are tested for hepatitis every three months. The costliness of this three-stage testing procedure has led the department to strive to limit the number of personnel from other departments (social service, dietary, housekeeping, etc.) assigned to renal dialysis, because even one working session in the unit will dictate the need for the test. Further, long-term isolation procedures are required for hepatitis patients, and several patients who have contracted the disease elsewhere are treated at the hospital.

Measurement of Capital Expenditures

The Standard Unit was converted from an existing pediatrics unit in 1972. The location of walls was largely unchanged, with most of the renovation involving installation of large glass windows and doors to enable the dialysis staff to observe the patients at all times. A large open space next to the nursing station is used for the patients requiring the closest observation, and the other patients use semi-private rooms. Nearly all patients use beds, and the adjacent dialysis machines contain individual pumping systems.

The Limited Care Unit was converted from laundry department storage space in 1974, and most of the renovation cost was for piping for a central dialysate pumping system. All of the dialysis stations are housed in one room, and the patients sit in chairs.

Although the self-contained dialysis units are more common today, it should be noted that there are no significant clinical advantages to either the individual or central pumping system.

The capital expenditures for the two renal dialysis units in expenditure year dollars, as well as the combined imputed/projected costs in 1977 dollars are summarized in Figure 39. Only the building costs are imputed to estimate the cost of fully constructing the units rather than renovating existing space.

The hospitals in the renal dialysis study are on a January-December fiscal year, such that the data for operating expenses lag behind that of the other study hospitals by six months. The conversion of capital costs to 1977 dollars was adjusted accordingly.

Volume of Service and Capacity

The unit of output for renal dialysis is the treatment, and calculation of percent utilization is dependent upon an assumption regarding the maximum number of treatments that can be provided per station per week. Renal dialysis is unique among patient services in that the treatment regimen is very long-term, usually interrupted only by the patient leaving the area or by kidney transplantation. Accordingly, it is possible to operate at very close to 100 percent of capacity if supported by a sufficient demand in the area. The study hospitals maintain a policy of operating two shifts per day, six days per week, which is relatively common practice among dialysis units (three shift operation is occasionally seen).

With the above capacity assumptions, the Standard Unit was operating very close to the optimal level at 95.5, while the Limited Care Unit was operating significantly below capacity at 50 percent during the study period (see Figure 40). The ratio of operating to capital costs for the Limited Care Unit is significantly distorted by the level of utilization. Returns to scale in terms of staffing and supply costs would be a minimal factor in extending to a second shift of operation (assuming that the second shift is also fully utilized), and thus, the study period operating costs are approximately half those which would be experienced at full capacity.

STANDARD UNIT

Type of Expenditures and Year	Expenditure Year Dollars	1977 Dollars
Building - 1972	$ 27,500[1/]	$293,264[2/]
Fixed Equipment - 1972	$ 5,331	$ 7,602
Movable Equipment - 1972	$229,932	$319,021
TOTAL	$262,763	$619,887

LIMITED CARE UNIT

Type of Expenditures and Year	Expenditure Year Dollars	1977 Dollars
Building - 1974	$ 50,000[1/]	$195,593[2/]
Fixed Equipment - 1974	$ 8,380	$ 10,319
Movable Equipment - 1974	$ 57,498	$ 73,605
TOTAL	$115,878	$279,517

[1/] Estimated cost for renovation of existing space.
[2/] Imputed cost for fully constructed unit.

FIGURE 39: RENAL DIALYSIS UNITS - CAPITAL EXPENDITURES

	Standard Unit	Limited
Total Treatments	7,201	3,388
Stations	13	12
Patient Status		
Acute	5-10%	0%
Chronic	90-95%	100%
Hospital Status		
Inpatient	20-25%	< 1%
Outpatient	75-80%	> 99%
Average Census		
Weekday-Day Shift	13	12
Weekday-Evening Shift	12	0
Saturday-Day Shift	13	12
Saturday-Evening Shift	11	0
Occupancy Rate		
Weekday-Day Shift	100%	100%
Weekday-Evening Shift	92%	. 0%
Saturday-Day Shift	100%	100%
Saturday-Evening Shift	85%	0%
Weighted Average (2-shift, 6-day operation)	95.5%	50.0%

FIGURE 40: RENAL DIALYSIS UNITS - VOLUME STATISTICS FOR JANUARY 1, 1976 THROUGH DECEMBER 31, 1976

Measurement of Direct Operating Costs

Direct costs for the Standard and Limited Care Renal Dialysis Units are summarized in Figure 41. The calculation of salary expenditures is explained in the paragraphs which follow, and the methods of obtaining estimates of the other components of direct cost are noted in the figure. The "other direct cost" category comprises 50 and 58 percent of total direct costs, respectively, for the two units, which is the highest such proportion among the five types of services studied. This is attributable primarily to specialized supplies related to dialysis, such as filters and tubing, which are ordered directly by the department rather than requisitioned through Central Services and Supply as is normally the case for the medical supplies utilized on inpatient units. Other significant costs are hepatitis tests and contract maintenance for the dialysis machines.

Figures 42 and 43 exhibit the planned and actual staffing for the two units. Both the part-time physician director and the head nurse split their time between the two units, on a 60-40 and 80-20 basis, respectively. The nurse aide and orderly time is shown only on the actual side, because these personnel were used only to fill in for absences and are not members of the Renal Dialysis Department staff. Personnel involved only in home care (specifically, three public health nurses and a part-time audio-visual specialist) are excluded from the analysis. In addition to the head nurse, a nurse coordinator is now employed for the two units, but the hours for this position are also excluded because the person was not hired until after the period of analysis.

The significant discrepancies between planned and actual staffing expressed in full-time equivalents is attributable primarily to two factors. First, the hospitals experienced significant turnover during the study period, in part due to a private renal dialysis clinic located in the vicinity expanding its operation to

Component of Direct Cost	Cost		Method of Calculation
	Standard Dialysis Unit	Limited Care Dialysis Unit	
Salary Cost	$329,656	$105,337	As calculated in Figures 42 through 44
Health and Welfare Benefits	$ 40,581	$ 13,926	Hospital average percent of salary expenses (12.31% for Standard Unit and 13.22% for Limited Care Unit)
Depreciation			Straight-line depreciation from 1977 dollar capital expenditures, with a useful life estimate of:
Building	$ 7,331	$ 4,890	40 years
Fixed Equipment	$ 422	$ 517	18 years
Movable Equipment	$ 35,447	$ 8,178	9 years
Other Direct Costs	$406,795	$181,665	Actual other direct costs
Total	$820,232	$314,513	

FIGURE 41 : RENAL DIALYSIS UNITS - SUMMARY OF DIRECT COSTS

PLANNED STAFFING PATTERN

Position	Day Shift Hours	Evening Shift Hours	Total Weekday Shift Hours	Saturday Day Shift Hours	Saturday Evening Shift Hours	Total Saturday Shift Hours	FTE - 6-Day Coverage
Physician Director	.75	.75	1.5	.75	.75	1.5	.23
RNs (including Head Nurse)	38.4	16	54.4	24	16	40	7.80
LVNs	24	24	48	16	16	32	6.80
Technicians	24	16	40	8	8	16	5.40
Clerical (Secretary & Ward Clerk)	16	8	24	-	-	-	3.00
Subtotal, Non-Physician	102	64	166.4	48	40	88	23.00
Total							23.23
Total with 12% allowance for vacation, sick, and holiday leave - applicable only to RNs, LVNs, and technicians							25.63

ACTUAL STAFFING PATTERN

Position	FTEs
Physician Director	.23
RNs (including Head Nurse)	8.60
LVNs	2.83
Technicians	12.40
Aides/Orderlies	.70
Clerical	2.40
Subtotal, Non-Physician	26.93
Total	27.16

FIGURE 42 : STANDARD RENAL DIALYSIS UNIT - COMPARISON OF PLANNED AND ACTUAL UTILIZATION OF PERSONNEL

PLANNED STAFFING PATTERN

Position	Day Shift Hours (Mon.-Sat.)	FTE 6-Day Coverage
Physician Director	.50	.08
RNs (including Head Nurse) 1/	16.60	2.48
LVNs	16.00	2.40
Technicians	12.00	1.80
Clerical (Secretary & Ward Clerk)	-	-
Subtotal, Non-Physician	44.60	6.68
Total	45.10	6.76
Total with 12% allowance for vacation, sick, and holiday leave - applicable only to RNs, LVNs, and technicians		7.56

ACTUAL STAFFING

Position	FTEs
Physician Director	.08
RNs (including Head Nurse)	1.50
LVNs	-
Aides/Orderlies	.10
Technicians	1.10
Clerical	-
Subtotal, Non-Physician	2.70
Total	2.78

1/ Monday through Friday only for head nurse.

FIGURE 43: LIMITED CARE RENAL DIALYSIS UNIT - COMPARISON OF PLANNED AND ACTUAL UTILIZATION OF PERSONNEL

a second shift. This resulted in a combination of reduced staffing at times and additional personnel in training at other times. The mix of nursing personnel on duty was often different than the planned staffing pattern due simply to staff availability. Second, the distribution of personnel between the two units (which operate as a system under one management) as reflected by payroll records do not match the distribution of personnel as they are assigned on a daily basis. For these reasons, the planned utilization was considered a much more accurate representation of the staffing requirements of the units than the actual utilization during the study period, and the planned number of FTEs was used to compute the salary costs in Figure 44. The discrepancy between the computed and cost report salary totals in Figure 44 reflects this difference in staffing representation, as well as the use of average salaries by personnel classification rather than the actual salaries of the individuals involved.

In order to assess the generalizability of the staffing data, comparison was made between the staff to patient ratios represented by the planned staffing at the study hospitals and those available from the literature. As seen in Figure 45, the ratios in both the Standard and Limited Care Units are lower than those suggested in two articles. However, the validity of these comparisons is limited because the published ratios were each based on the experience of only one hospital. A study with the objective of recommending appropriate staffing levels for renal dialysis units could not be found in the literature.

Measurement of Indirect Costs

The amounts allocated and bases of allocation for general and ancillary services are listed in Figure 46.

Within the general service departments, the method of allocation used for Medicare reporting was changed for the Business Office (within Administration and General) and Dietary Departments, in each case to reflect above average utilization of the service. The net effect of the two changes was an increase of $20,367 (Standard Unit)

STANDARD UNIT

Position	FTEs[1/]	Average Salary	Estimated Salary Cost - FY 1976
Physician Director	.23	$ 45,000 (for 12 hour week)	$ 33,750
RNs (including Head Nurse)	8.74	$ 14,352	$ 125,436
LVNs	7.61	$ 10,026	$ 76,298
Technicians	6.05	$ 11,378	$ 68,837
Clerical (Secretary & Ward Clerk)	8.00	$ 8,445	$ 25,335
Total	25.63		$ 329,656
Cost Report Total			$ 450,454

LIMITED CARE UNIT

Position	FTEs[1/]	Average Salary	Estimated Salary Cost - FY 1976
Physician Director	.08	$ 45,000 (for 12 hour week)	$ 11,250
RNs (including Head Nurse)	2.78	$ 41,955	$ 41,575
LVNs	2.69	$ 10,025	$ 26,967
Technicians	2.01	$ 12,709	$ 25,545
Clerical (Secretary & Ward Clerk)	-	-	-
Total	7.56		$ 105,337
Cost Report Total			$ 50,998

[1/] FTEs represent the planned staffing pattern as per Figures 42 and 43, with a 12 percent allowance for vacation, sick, and holiday added only to the RN, LVN, and technican categories.

FIGURE 44: RENAL DIALYSIS UNITS - FULL-TIME EQUIVALENTS CONVERTED TO DOLLARS AND COMPARED TO COST REPORT FIGURE

STANDARD UNIT

Suggested Nurse Staffing per Patient[1]	1 RN or LPN for every 2 - 3 patients
Study Hospital's Planned Nurse Staffing per Patient	1 RN or LPN for every 2.0 patients

[1] Janice M. Flegle, "Teaching Self-Dialysis," American Journal of Nursing, Vol. 77, No. 2, (February 1977), p. 271.

LIMITED CARE UNIT

Suggested Staffing per Patient[1]	1 RN, LPN, or Technician to every 3.5 patients	Suggested Staffing per Patient[2]	1 RN or LPN to every 4-6 patients
Study Hospital's Planned Staffing per Patient	1 RN, LPN, or Technician to every 2.2 patients	Study Hospital's Planned Staffing per Patient	1 RN or LPN to every 3.0 patients

[1] Dan B. McLaughlin and Fred L. Shapiro, M.D., Regional Kidney Disease Network Offers Efficient Care, Operation," Hospitals, Vol. 50 (January 1, 1976), p. 90.

[2] Janice M. Flegle, "Teaching Self-Dialysis," American Journal of Nursing, Vol. 77, No. 2 (February 1977),

Note: None of the three staffing ratios were meant to be generalizable "standards." The authors stated that these were the ratios utilized in their respective facilities.

FIGURE 45 : RENAL DIALYSIS UNITS - COMPARISON OF STUDY UNIT AND SUGGESTED STAFFING RATIOS

Cost Center	Cost Allocated		Base of Allocation
	Standard Unit	Limited Care Unit	
GENERAL SERVICES			
✸ Administration & General	$119,303	$ 43,360	See explanatory note
Operation of Plant	$ 29,440	$ 23,153	Time spent
Laundry & Linen	$ 12,778	$ 2,955	Pounds
Housekeeping	$ 54,935	$ 22,114	Hours worked
✸ Dietary	$ 34,043	$ 22,207	See explanatory note
Cafeteria	$ 6,715	$ 4,204	FTEs (Renal Dialysis staff)
Nursing Administration	$ 28,156	$ 17,453	Time spent
Central Services	$ 22,379	$ 1,240	Costed requisitions
Pharmacy	$ 6,977	$ 5,697	Costed requisitions
Medical Records	$ 4,973	$ 2,672	Patient days
Social Service	$ 20,367	$ 12,260	Time spent
Subtotal - General Service Costs	$340,066	$157,315	
ANCILLARY SERVICES			
Laboratory	$ 66,565	$ 30,865	Ratio-of-charges-to-charges-applied-to-costs (RCCAC)
Radiology	$ 9,977	$ 4,061	RCCAC
Drugs Charged to Patients	$ 7,381	$ 3,204	RCCAC
Blood & Blood Processing	$ 15,183	$ 5,280	RCCAC
EKG & EEG	$ 2,702	$ 1,047	RCCAC
Occupational Therapy	$ 14,227	N/A	Time spent
Recreational Therapy	$ 17,926	$ 10,528	Time spent
Subtotal - Ancillary Service Costs	$133,961	$ 54,985	
TOTAL - General & Ancillary Service Costs	$474,027	$212,300	

✸ These costs differ from those indicated on the Medicare Cost Report
- The cost report allocated $109,754 and $33,473, respectively, for Administra- General
- The cost report allocated $23,364 and $15,830, respectively, for Dietary

FIGURE 46: STANDARD AND LIMITED CARE RENAL DIALYSIS UNITS - INDIRECT COSTS

and $16,260 (Limited Care Unit) in the costs allocated. The following are comments specific to these and other general service allocations.

- Administration and General

  Administration and General (A&G) uses accumulated costs as the statistical base of allocation. However, the Business Office of each study hospital employs one full-time clerk whose sole responsibility is handling the accounts of the dialysis patients. There is a separate "check-in" window for renal dialysis patients adjacent to the window for all other patients. In order to account for this factor, the salary of the clerks ($8,832 in each case) plus fringe benefits were subtracted out from total A & G costs, the remaining A & G costs were allocated to all applicable departments, including Renal Dialysis, and then the cost of the above personnel were added back to the Renal Dialysis Units. It should also be noted that the Business Office reported above average time commitments of managerial personnel (including the controller) to the Renal Dialysis Departments, largely due to reimbursement matters.

- Operation of Plant

  Most hospitals use square feet as the base of allocation for operation of plant, but these two hospitals use an estimate of actual time spent. This difference is important, because the renal dialysis units do place unusual demands on the Plant Department. In addition to normal maintenance functions, a bio-medical engineer spends an estimated 14 hours in one unit and 6 hours in the other per week performing equipment maintenance. These costs are reflected in the allocations, as per the Medicare Cost Reports.

- Dietary

  The dietary department's allocation is based upon the number of meals served. However, because dialysis patients require stringent diet control in the hospital and at home, a dictitian spends an estimated 25 and 15 hours per week in the two units performing meal planning functions and counseling the patients. The salary costs of the dietitian working in the Renal Dialysis Departments ($9,715 and $5,705, respectively) plus fringe benefits was handled in the same manner as explained above for Business Office personnel.

- Medical Records

  The statistical base of allocation for Medical Records is patient days. However, the hospital has made an adjustment in the calculation to weight a dialysis treatment as

17 percent of a patient day to reflect the estimated ratio of time spent on dialysis charting in comparison to that for inpatients.

- Social Service

  Time spent is the base of allocation for Social Service, and the time allocations were 1.0 FTE for the Standard Unit and 0.2 FTE for the Limited Care Unit. The cost allocations on the Medicare Cost Report appear not to reflect this utilization differential.

	FTEs	Cost Report Amount	Implied Cost per FTE
Standard Unit	1.0	$20,367	$20,367
Limited Care Unit	0.2	$12,260	$61,300

  The difference, however, is attributable to returns to scale. The former Social Service Department has overhead salaries (a portion of the department director's time and a scretary) spread over 12 FTEs, while the latter has such costs spread over 2 FTEs.

The Laboratory, Radiology, EEG, EKG, Blood Bank and charged drug costs applicable to Renal Dialysis were estimated using the RCCAC method (i.e., patient charges as the base of allocation). The Occupational Therapy (OT) and Recreational Therapy (RT) allocations were constructed by estimating the salary and "overhead" costs of the specific personnel assigned to work in Renal Dialysis. The FTEs utilized are as follows:

	OT-FTEs	RT-FTEs
Standard Unit	0.5	0.63
Limited Care Unit	-	0.37

The overhead allowance would account for supervisory and secretarial time in the OT and RT departments, health and welfare benefits, supplies, and a share of the OT and RT departments' overhead (depreciation for office space utilized, etc.). The data were not available to estimate this overhead factor, but a similar analysis performed as part of the Burn Treatment Center analysis suggests that 90 percent of salaries is an appropriate allowance. Thus, the allocation is summarized as follows:

	Salary		% FTE		Overhead Allowance		Cost Allocated
Standard Unit							
Occupational Therapy	$14,976	x	.50	x	1.9	=	$14,227
Recreational Therapy	$14,976	x	.63	x	1.9	=	$17,926
Limited Care Unit							
Occupational Therapy	-		-		-		-
Recreational Therapy	$14,976	x	.37	x	1.9	=	$10,528

Charge data were not available for OT and RT, such that it was not possible to compare the amounts calculated as above with those obtained by the RCCAC method.

MEDICAL-SURGICAL UNITS

Westmoreland Hospital

An introduction to Westmoreland Hospital was provided at the beginning of the linear accelerator section of the report.

Inpatient Medical-Surgical Care

Short-term, acute care hospitals typically maintain several nursing or patient units for the inpatient care of patients requiring "routine" medical and surgical care. These units, normally ranging in size from 15 to 40 beds, complement one or more units maintained for the treatment of patients within a specific medical service (e.g., obstetrics/gynecology unit) or for the treatment of complex or severe cases (e.g., intensive care unit). Patients on medical-surgical units are under the care of an attending physician (possibly supplemented by interns and residents), receive continuous nursing care, and can obtain the gamut of the diagnostic and therapeutic services available in the hospital, either in their rooms or by transport to ancillary departments.

Because of the wide variety of diseases and conditions treated on medical-surgical units (i.e., case mix), it is difficult to generalize regarding the input factors and hence cost of such care. While the required staffing in per patient day terms on the units themselves, the primary determinant of direct costs, will vary within a reasonably narrow range, the nature and quantity of ancillary services utilized will vary tremendously as a function of case mix and the scope of service offered by the hospital.

The Medical-Surgical Units at Westmoreland Hospital

Two 30 bed units which are part of a seven unit medical-surgical care system at Westmoreland were under study. These units are complemented by inpatient psychiatric, pediatric, maternity, nursery, neurosurgical, intensive care, and cardiac care units.

As summarized in Figure 47, the units are staffed by a shared head nurse, registered nurses, licensed practical nurses, nurse aides

and orderlies, and unit clerks. A supervisor employed by the Nursing Administration Department is assigned to oversee these and other units on all three shifts, and a floating intravenous therapy team is available to serve the units.

Department Staff

- Head nurse (shared between two units)
- Registered nurses
- Licensed practical nurses
- Aides/orderlies
- Clerks

Diagnostic and Therapeutic Procedures

- All services offered by the ancillary departments of the hospital on order of any member of the medical staff admitting patients

Special Cost Considerations

- IV start-ups performed by a floating team rather than the unit personnel
- Pool of RNs and LPNs and inter-unit transfers available for staff absences and periods of peak demand

FIGURE 47 : MEDICAL-SURGICAL UNITS - INPUT FACTORS

The hospital maintains a "staff-leveling system" whereby the staff requirements of all patient units are measured daily, accounting for fluctuations in census and average nurse dependency level. A pool of non-permanently assigned nursing personnel are utilized to fill in for absences as well as to adjust for fluctuating personnel requirements by unit as measured by this system. Permanently assigned personnel may also be temporarily transferred among

all units with the exception of the psychiatric unit, if the distribution of personnel requirements on a given day so dictates.

Measurement of Capital Expenditures

The two medical-surgical units under study were completed in 1972 and were constructed as part of a project to finish these two units and shell in two similar units on the third and fourth floors. The building contractor's estimate of the construction and fixed equipment costs associated with the two shells were subtracted from the total project cost to arrive at the estimate shown in Figure 48. Available data did not permit separation of building costs from fixed equipment costs. The movable equipment costs shown are specific to the two fully-constructed units.

Type of Expenditure and Year	Expenditure Year Dollars	1977 Dollars
Building - 1972 Fixed equipment - 1972	$ 728,179	$1,076,249
Movable Equipment - 1972	$ 52,360	$ 72,647
Total	$ 780,539	$1,148,896

FIGURE 48 : MEDICAL-SURGICAL UNITS - CAPITAL EXPENDITURES

Volume of Service and Capacity

As seen in Figure 49, the two study units are operating at the unusually high occupancy rate of 97.8 percent, and, in fact, this rate is representative of all of the medical-surgical units at the study hospital. The difference between this virtually maximum utilization rate and the commonly cited minimum acceptable rate of 80 percent will have a significant impact on the need for construction of additional facilities, and will also serve to constrain nurse staffing costs on a per patient day basis. While considerations

Patient Days	10,713
Average Daily Census	29.4
Beds	30
Percent Occupancy	97.8%

FIGURE 49 : MEDICAL-SURGICAL UNITS - VOLUME STATISTICS

of scale generally have little impact on nurse to patients ratios on units within the 30 bed range, fluctuation in census may well cause staffing patterns to be established significantly higher than needed to treat the average patient load. Obviously, the census cannot fluctuate at 97.8 percent average occupancy. Rather, a uniform census level is achieved through scheduling of non-emergency admissions, undoubtedly through maintenance of a fairly lengthy waiting list.

Measurement of Direct Operating Costs

Direct operating costs for the two medical-surgical units are summarized in Figure 50. The calculation of salary costs is addressed below, and the methods of calculation for the other components of direct cost are noted in the Figure. The "other direct costs" represent a low proportion (3%) of the total and are comprised of such items as instruments, staff continuing education, and various supply items.

Figure 51 compares planned staffing with actual man hours for the two units. The nursing pool which was used for personnel substitution on these and other units was prorated on the basis of person-hours (i.e., the two units consume 15.8% of the hours for all units except the psychiatric unit, and hence are assumed to utilize the same percentage of the 13,200 pool hours $\cong$ 0.5 FTE).

Component of Direct Cost	Cost	Method of Calculation
Salary cost	$ 484,290	As calculated in Figures 51 and 52
Health and Welfare Benefits	$ 82,426	Hospital average percent of salary expenses (17.02%)
Depreciation		Straight-line depreciation from 1977 dollar capital expenditures, with a useful estimate of:
Building, Fixed Equipment	$ 30,750	35 years
Movable Equipment	$ 8,072	9 years
Other Direct Costs	$ 18,510	Allocation of actual other direct costs between study units and other adult and pediatric units on the basis of percent of patient days
Total	$ 624,048	

FIGURE 50 : MEDICAL-SURGICAL UNITS - DIRECT COSTS BY COMPONENT

The FTEs resulting from the staffing pattern, with a 12 percent allowance for vacation, sick and holiday, are 9.4 percent lower than the number of actual personhours, raising the question of whether the actual personnel utilization is really a good representation of the labor input required to operate such a unit. Two factors suggest it is not:

PLANNED STAFFING PATTERNS

Position	Day Shift Hours	Eve. Shift Hours	Night Shift Hours	Total Hours	FTEs - 7 - Day Coverage
Head Nurse[1/]	4	-	-	4	.5
Registered Nurses	32	16	8	56	9.8
Licensed Practical Nurses	8	8	8	24	4.2
Aides/Orderlies/ Clerks	24	16	8	48	8.4
Total	68	40	24	132	22.9
Total with 12% allowance for vacation, sick and holiday					25.6

ACTUAL STAFFING

Position	FTEs[2/]
Head Nurse	.5
Registered Nurses	11.6
Licensed Practical Nurses	5.0
Aides/Orderlies /Clerks	10.8
Share of Pool	.5
Total	28.4

[1/] One head nurse split between the two 30-bed patient units, and the position is not replaced on weekends.

[2/] Average of the two units studied.

FIGURE 51: MEDICAL–SURGICAL UNITS - COMPARISON OF PLANNED AND ACTUAL UTILIZATION OF PERSONNEL

- The most common explanation for actual staff utilization being higher than programmed on a per patient day basis is contingency staffing for variability in patient load. As mentioned earlier, this is a negligible factor at the study hospital because of the extremely high occupancy rate.
- Personhour statistics on medical/surgical units are generally suspect, because staff are assigned to one unit, but are frequently transferred on a day-to-day basis to fill in for absences and adjust for fluctuating staff requirements among units, as discussed earlier. A net outflow of staff over the year may therefore explain a good part of the difference between planned and actual staffing.

For these reasons, planned staffing (25.6 FTEs) was utilized for the calculation of salary expenditures. Figure 52 converts the planned staffing to dollars using average salary rates by personnel classification. Comparison of this simulated salary cost with that shown on the Medicare Cost Report, as done for several of the other service areas in this study, was not possible because the two units are not separate cost centers, and as a result the necessary data were not available from the hospital.

Position	FTEs[1/]	Estimated Average Salary	Annual Cost
Head Nurse	.56	$14,304	$ 8,010
Registered Nurses	10.97	$11,447	$125,574
Licensed Practical Nurses	4.70	$ 8,570	$ 40,279
Aides/Orderlies/ Clerks	9.40	$ 7,264	$ 68,282
Total	25.6		$242,145

1/ Full-time equivalents represent the planned staffing pattern for a 30 bed unit, as per Figure 51, with a 12 percent allowance for vacation, sick, and holiday added to each personnel classification.

FIGURE 52 : MEDICAL-SURGICAL UNITS - DIRECT SALARY COST

To assess the generalizability of the above staffing data, the planned staffing for the units was compared with staffing patterns suggested for a comparable average daily census in a study conducted using industrial engineering techniques by the Commission for Administrative Services in Hospitals, of California (see Figure 53). CASH recommends 4.1 hours per patient day, but the 4.3 shown in the figure results from their "rounding up" to the nearest full position. There are two notable differences between the two staffing patterns:

- The study hospital has 4 additional hours per day, the amount implied by one head nurse shared between the two units. They also have assistant head nurses on each unit, which are comparable to the head nurses allowed for in the CASH staffing recommendations.
- The study hospital has a considerably higher ratio of RN to other staff, consistent with their statements that this ratio probably was higher than that of comparable hospitals for reasons of quality of care.

Measurement of Indirect Costs

The fact that the study units are not cost centers for Medicare reporting dictated the need for a two step process for allocation of general service costs: allocation to the Adult and Pediatrics grouping and then allocation to the two study units. This approach may bias the analysis to some extent, because the pediatrics unit is not entirely comparable to the medical-surgical units. However, the difference between the two types of units is much less significant in terms of support service usage than in terms of direct salary costs, which were measured entirely specific to the two units.

The base of allocation used for Medicare reporting of general service costs was changed in several cases, as noted in Figure 54 and discussed by service below. In the majority of cases, the percentage of patient days was used as the base for the second level of allocation, and exceptions to this approach are also noted in the discussion below.

	Staffing Census	Day Shift Hours	Evening Shift Hours	Night Shift Hours	Total Hours	Hours Per Patient Day
Study Unit	30					
RN		36[1/]	16	8	60	
LPN		8	8	8	24	
Aide/Orderly/ Clerk		24	16	8	48	
TOTAL		68	40	24	132	4.4
CASH Recommendation	30					
RN		16	16	8	40	
LPN		8	8	0	16	
Aide/Orderly/ Clerk		32	24	16	72	
TOTAL		56	48	24	128	4.3

[1/] Includes 4 hours head nurse time which is not replaced on weekends.

SOURCE: Nursing Service Staff Utilization and Control Program: Orientation Report-Medical/Surgical, Commission for Administrative Services in Hospitals, Pg. 11

FIGURE 53: MEDICAL-SURGICAL UNITS - COMPARISON OF STUDY UNIT AND SUGGESTED STAFFING LEVELS

Cost Center	Cost Allocated	Base of Allocation	
		To All Adult and Ped. Units	To Study Units
GENERAL SERVICE COST CENTER			
Non-Patient Telephone	$ 3,296	Telephones	Patient units
Data Processing	$ 753	Various	Patient days
Purchasing	$ 273	Non-Salary Cost	Patient days
* Admitting	$ 18,961	Inpatient Charges	Patient days
Cashiering, Accounts Receivable, Collections			
Accounts Receivable Inpatient	$ 13,312	Inpatient Charges	Patient days
Credit and Collections	$ 7,922	Total Charges	Patient days
Administration and General			
* Social Services	$ 6,944	Approximation of Hours Worked	Patient days
* Utilization Review	$ 9,171	Inpatient Charges	Patient days
* Volunteers	$ 4,218	Inpatient Charges	
* Bond Interest	N/A		
Other Administration and General	$ 54,323	Accumulated Cost	Patient days
Plant Engineering	$ 75,807	Square Feet	Beds
Laundry & Linen Service	$ 50,055	Pounds	Patient days
Housekeeping	$ 73,675	Hours Worked	Patient days
Dietary	$186,437	Meals	Patient days
Cafeteria	$ 6,058		Employees

*In most cases, the general and ancillary service costs were allocated using a two-step process: allocation to Adults and Pediatrics (a cost center on the Medicare Cost Report), then allocation to the two study units. The asterisks connote a change in the base of allocation for Adults and Pediatrics from the base used for Medicare reporting.

FIGURE 54 : MEDICAL-SURGICAL UNITS - INDIRECT COSTS

Cost Center	Cost Allocated	Base of Allocation	
		To all Adult and Ped. Units	To Study Units
Nursing Administration			
I.V. Team & Escort Service	$ 21,903		Patient days
Other Nursing Administration	$ 46,915		Personhours
Central Services and Supply	$ 11,376	Costed Requisitions	Patient days
Pharmacy	$ 1,434	Costed Requisitions	Patient days
Medical Records and Library	$ 42,161	Time Spent	Patient days
* Patient Telephone	$ 6,083	Inpatient Charges	Patient days
Subtotal-General Service Costs	$ 641,088		
ANCILLARY SERVICES			
Operating Rooms	$ 114,528	Ratio-of-charges-to-charges-applied to-costs	Direct Costs
Recovery Rooms	$ 15,119	RCCAC	Direct Costs
Anesthesiology	$ 46,601	RCCAC	Direct Costs
Radiology-Diagnostic	$ 120,734	RCCAC	Direct Costs
Radiology-Oncology	$ 6,900	RCCAC	Direct Costs
Laboratory	$ 140,107	RCCAC	Direct Costs

*In most cases, the general service and ancillary costs were allocated using a two-step process: allocation to Adult and Pediatrics (a cost center on the Medicare Cost Report) then allocation to the two study units. The asterisks connote a change in the base of allocation for Adults and Pediatrics from the base used for Medicare reporting.

FIGURE 54: MEDICAL-SURGICAL UNITS - INDIRECT COSTS (Continued)

Cost Center	Cost Allocated	Base of Allocation	
		To All Adult and Ped. Units	To Study Units
Inhalation Therapy	$ 39,455	RCCAC	Direct Costs
Physical Therapy	$ 10,383	RCCAC	Direct Costs
Electrocardiology	$ 27,023	RCCAC	Direct Costs
Electroencephalography	$ 5,120	RCCAC	Direct Costs
Medical Supplies Charged to Patients	$ 69,252	RCCAC	Direct Costs
Drugs Charged to Patients	$ 94,838	RCCAC	Direct Costs
Subtotal-Ancillary Service Costs	$ 690,060		
Total General Service and Ancillary Service Costs	$1,331,148		

FIGURE 54: MEDICAL-SURGICAL UNITS - INDIRECT COSTS (Continued)

- Non-Patient Telephone

  These costs were allocated to the study units (second level of allocation) by assuming that the number of telephones on each of the 10 units within Adult and Pediatrics would be equal.

- Data Processing

  Data processing is allocated according to several statistical bases by type of service (payroll, management reports, etc.), and the amount applicable to the study units was $753. While this amount appears questionably small, a large percentage of D.P. costs are allocated to Accounts Receivable, Cashiering and Collections, which in turn has its costs allocated to patient care departments.

- Admitting

  Unlike the approach utilized by the hospital, Admitting Department costs were allocated only to inpatient units, as these units are the only direct users of the Admitting Department's services. An accurate method of allocating Admitting costs among the inpatient departments would be by number of admissions (i.e., each patient admitted creates a need for a set of admitting services). However, the necessary data were not available, so inpatient charges had to be used, which probably understates the cost attributable to these medical-surgical units in contrast to such units as ICU and CCU.

- Cashiering, Accounts Receivable, Collections

  As discussed under the linear accelerator, this cost center covers two hospital departments, Accounts Receivable (Business Office) and Credit and Collections. To more accurately allocate Accounts Receivable costs, this department was further divided into inpatient and outpatient sections according to the ratio of salary costs of the employees working in each section. Inpatient Accounts Receivable was then allocated by inpatient charges. If it is assumed that processing time increases with charges (i.e., with more ancillary services, longer length of stay), and this is no doubt true in part, then charges rather than admissions is the appropriate base of allocation for this cost center.

- Administration

  .. Social Services

  Costs in this department were allocated according to "approximate usage" to various patient care departments, because there was no record of hours spent available from the hospital.

  .. Utilization Review

  These costs were allocated to inpatient departments according to inpatient charges. Similar to the case for Admitting costs, number of admissions may have been a more appropriate base of allocation, but the necessary data were not available.

  .. Volunteers

  These services are used by all inpatient departments and the Operating Rooms. Inpatient charges were used as the base of allocation.

  .. Bond Interest

  Inapplicable to the study units.

- Plant Engineering (maintenance and operation of plant)

  Plant Engineering costs were allocated to the study units (second level of allocation) on the basis of number of beds in order to capture the correlation between such costs and amount of space occupied.

- Housekeeping

  Housekeeping services are allocated on the basis of the hospital's estimate of hours worked by department, which does reflect the fact that inpatient units are heavy users of such services. The costs were then allocated to the study units on the basis of patient days. This is believed to be a more appropriate base of allocation than beds in this case, because occupied beds do require a significantly higher level of service than empty beds.

- Nursing Administration

  .. I.V. Team and Escort Service

  These costs are discussed here because such centralized services could be considered conceptually as part of nursing administration, although they are reported by the hospital as part of Adults and Pediatrics. The total costs of the I.V. Team and Escort Service were available from the internal accounting records of the hospital and were allocated among the Adult and Pediatrics units on the basis of patient days.

.. Other Nursing Administration

This cost center includes management (e.g., director of nursing), supervision, continuing education, and infection control nurse. Because the largest components of the cost center, supervision and continuing education, are a function of the nursing staff served, costs were allocated to the study units according to the staff personhours.

Unfortunately, patient charges for ancillary services were not available broken-down by patient unit, so the RCCAC method could not be utilized to estimate ancillary service costs applicable to the two study units. The next best approximation was thought to be the ratio of direct costs on the study units to direct costs for all inpatient units, applied to inpatient ancillary service costs as per the Medicare Cost Report. Although weak in the sense that the ratio does not directly reflect relative utilization of each ancillary service (as the RCCAC method does), this method at least reflects the general correlation between high direct costs and high utilization of ancillary services (e.g., ICU patients require extensive nursing coverage and also generally utilize ancillary services such as laboratory, radiology, operating rooms, and EKG extensively).

The study units represent 12.2 percent of the total inpatient unit direct costs for the hospital, and this percentage was uniformly applied across the 12 ancillary service cost centers shown in Figure 54 to arrive at the allocations for the two units.

SHOCK-TRAUMA CENTER

Maryland Institute for Emergency Medical Service

The Maryland Institute for Emergency Medicine (MIEM), an autonomous institute within the University of Maryland, is a specialized facility for the treatment of critically ill and injured patients. As a statewide shock-trauma (S-T) center located in Baltimore at the University of Maryland medical school and adjacent to University Hospital, it serves the State of Maryland and surrounding region. On July 1, 1977, MIEM merged with the Division of Emergency Medical Services (DEMS) of the Maryland Department of Health and Mental Hygiene and the new entity is officially called the Maryland Institute for Emergency Medical Services (MIEMS). During the period of analysis, MIEM was a separate entity and since the DEMS activity is external to the S-T center it is not included.

In Maryland's Echelons of Trauma Care, the local hospital emergency room is the basic level, handling 85 percent of all emergency treatment. On a higher level are designated areawide trauma centers which meet standards stricter than those set by the American College of Surgeons. The centers are located in community hospitals which have reordered priorities in the emergency room, operating room and critical care unit to respond to the needs of trauma victims. The centers handle the next, more serious 15 percent. At the highest level is the statewide shock-trauma center, MIEMS, capable of treating the most critically ill and injured patients. It is the only statewide unit in the nation.

Accidents on the highway are the most frequent source of patients requiring emergency services. These patients frequently have multiple injuries and are in shock. The EMS communication system (SYSCOM) coordinates transport in the State Police Med-Evac helicopter or by ambulance and alerts the admitting room staff of the adult patient's arrival. Pediatric and burn patients and those patients with hand injuries are triaged at the accident site to specialty referral centers.

Referring to Figure 55, patients are met by a physician and nurse who take immediate steps to make sure an airway is maintained and accompany the patient to the admitting area which is a diagnostic operating room. There, a multidisciplinary team of physicians and nurses resuscitate and stabilize the patient. Their armamentarium includes intravenous lines, monitoring devices, resuscitative and diagnostic equipment, including x-ray. Seven patients can be admitted simultaneously. Two adjacent operating rooms are available when immediate surgery is required.

Once stabilized the patient is taken to the Critical Care Recovery Unit (CCRU) where he is monitored. His care is directed by a physician team leader and a primary nurse with multidisciplinary specialists and therapists available for consultation and treatment. The patient's stay in the CCRU will depend on the extent of his problem.

When CCRU level of care is no longer required, the patient is transferred to the Intensive Care Unit (ICU) whose staff and facilities are similar to ICUs in other hospitals. An Intermediate Care Unit on the same floor is used for patients who no longer require ICU care but are

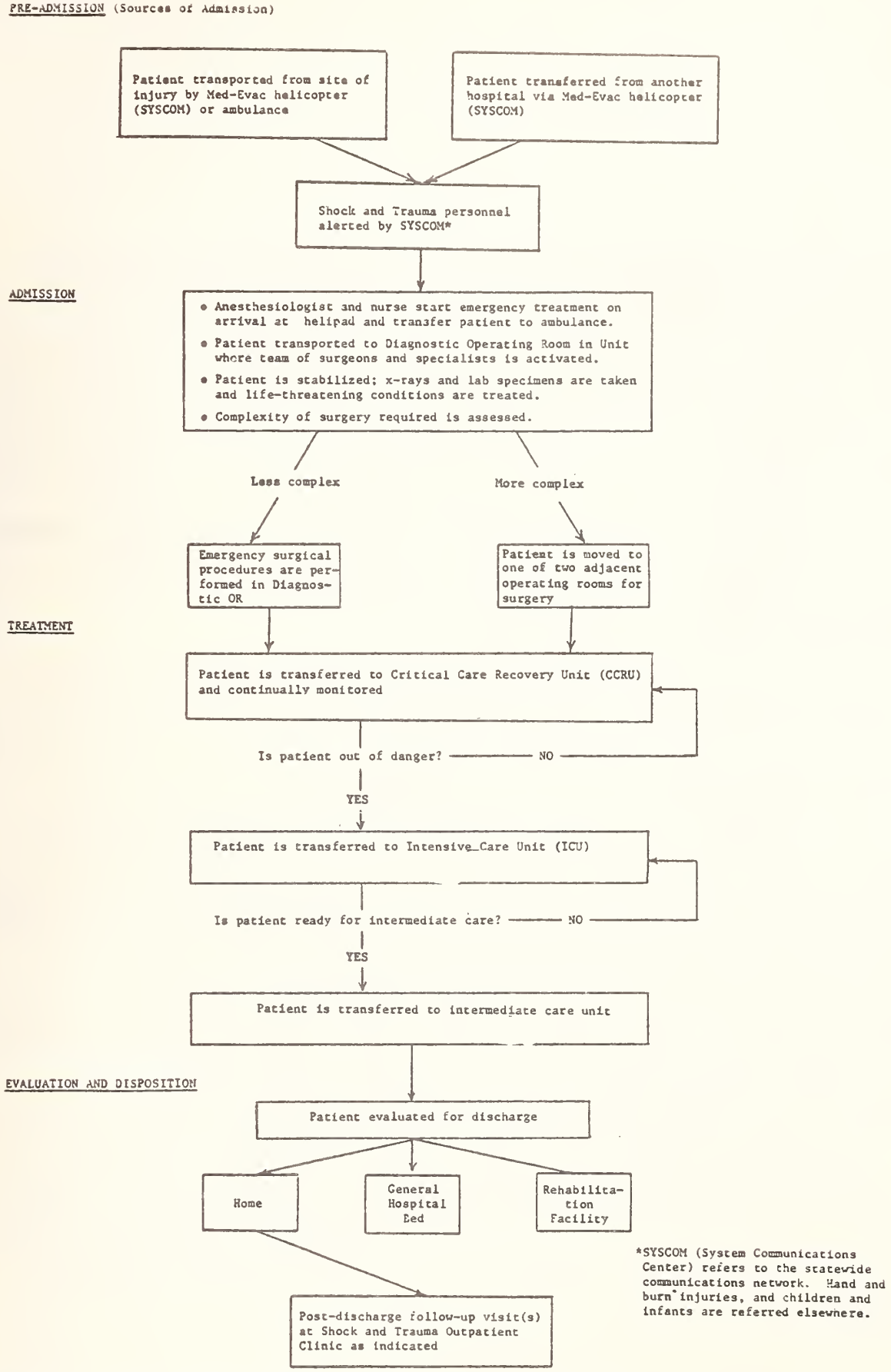


FIGURE 55: SHOCK-TRAUMA CENTER - EVENT-ORIENTED FLOW CHART

not ready for discharge from the shock-trauma center. Although more intensive, the care delivered in this unit is comparable to routine hospital care. Patients discharged from the shock-trauma center may be transferred to another hospital, a rehabilitation unit or home with followup in the shock-trauma center's outpatient clinic. In addition to patient care, MIEM staff is also active in trauma-related research and an extensive education program directed to health care professionals and the general public.

Measurement of Capital Expenditures

The construction of the five story facility was completed in 1969, although the operating rooms were completed at a later date. Data include all additions to the unit following the opening.

The equipment list did not segregate items purchased for replacement which may have resulted in a slight overstatement of the original capital expenditures for equipment. However moveable equipment capital expenditures do not include two portable x-ray machines, an EEG machine and two EKG machines which are used in the S-T center. The EEG and EKG machines belong to the shock-trauma center. The x-ray machines belong to the hospital Diagnostic X-ray Department which provides all x-ray personnel and services.

In 1976, the Shock-Trauma Center purchased a computer ($213,000) which is to be used exclusively for the patient information system which is being developed. This item was included in the 1976 expenditure for moveable equipment.

The capital expenditures in purchase year dollars are as follows:

Construction and Fixed Equipment	$1,194,052
Moveable Equipment	
1969	123,312
1970	31,992
1971	23,685
1972	141,939
1973	40,883
1974	68,984
1975	112,292
1976	255,893
	$ 798,979

Using the Boeckh Index, the expenditures were inflated to 1977 dollars as follows:

Construction and Fixed Equipment	$2,268,371
Moveable Equipment	979,882

Volume of Service and Capacity

Referring to Figure 56, the average daily census unit is based on bed occupancy or the type of patient occupying the bed. Thus if an intermediate care patient was occupying an intensive care bed the patient would be classified as an intermediate care bed patient. This accounts for the high average daily census for intermediate care beds (9.6) when the unit contained only six beds at the beginning of the fiscal year and only was expanded to ten beds toward the end of the year.

Admissions		1,023
Patient Days		
Critical Care Recovery Unit	2,561	
Intensive Care Unit	3,228	
Intermediate Unit	3,521	
TOTAL		9,310
Beds		
Critical Care Recovery Unit	12	
Intensive Care Unit	14	
Intermediate Unit	10	
TOTAL		36
Average Daily Census		
Critical Care Recovery Unit	7.0	
Intensive Care Unit	8.8	
Intermediate Unit	9.6	
TOTAL		25.5
Occupancy Rate		
Critical Care Recovery Unit	58.5%	
Intensive Care Unit	63.2%	
Intermediate Unit	96.5%	
TOTAL		70.8%

FIGURE 56: SHOCK-TRAUMA CENTER - Volume Statistics for July 1, 1976 - June 30, 1977

Measurement of Direct Operating Costs

The components of direct cost for the shock-trauma center are summarized in Figures 57 and 58. Except where noted the expenses allocated are taken from the State of Maryland fiscal year 1977 financial report.

There are four major patient care areas in the shock-trauma center. Non-physician staff is assigned to each of these areas which is also a cost center. The personnel costs for the Intensive Care Unit and Intermediate Care Unit were imputed. In fiscal 1977 the Intermediate Care Unit was expanded from six to ten beds. Even at six beds the budgeted number of nurses was inadequate. It was determined that nurses from the Intensive Care Unit were assigned to fill the gap. Since the two units adjoin each other this was an effective solution in the short tun. Floaters were used when necessary. As a result the costs for the Intermediate Care Unit were imputed to include a staff of 14 nurses in addition to support personnel. The actual costs of the Intensive Care Unit were reduced to accomodate a staffing pattern which did not require coverage of both units. This includes 30 nurses as well as support personnel. Forty-four nurses are assigned to the Critical Care Unit.

The amounts included for Physician Services incorporate three budget categories: Physician Services, Operating Room Surgeons and Psychiatric Consultation.

Component of Direct Cost	Cost
Salaries	$ 2,960,742
Health and Welfare Benefits	407,250
Depreciation:	
Bulding and Fixed Equipment	19,165
Moveable Equipment	93,247
Other Direct Costs	1,058,329
Total	$ 4,538,733

FIGURE 57: SHOCK-TRAUMA CENTER - Summary of Direct Costs

FIGURE 58: SHOCK-TRAUMA CENTER - DIRECT COSTS BY COMPONENT DEPARTMENT

Department	Salaries	Health & Welfare	Operating Expenses	Department Total
Critical Care Unit	$674,053	$93,774	$266,789	$1,034,616
Intensive Care Unit**	390,000	58,500	171,283	619,783
Intermediate Care Unit**	225,000	33,750	48,317	307,067
Operating Rooms	480,880	68,776	227,285	776,941
Clinical Laboratory	164,991	23,489	41,690	230,170
Inhalation Therapy	30,830	4,331	29,373	64,534
Anesthesiology	104,073	10,831	9,460	124,364
Physician Services*	316,873	32,833	-0-	349,706
Administration				
General***	312,047	43,479	204,208	559,734
Medical Staff	79,572	9,928	13,229	102,729
Nursing **	39,228	5,884	2,106	47,218
Social Services**	62,086	9,313	3,500	74,899
Medical Records**	20,160	3,080	3,000	26,240
Central Supply (Material Handling)	56,449	8,427	29,089	93,965
Outpatient Clinic**	4,500	855	9,000	14,355

* Includes operating room surgeons and psychiatric consultation
** Imputed Costs
*** Includes Data Processing item for Patient Information System

Under Administration, "General" includes, in addition to the actual expenses incurred in that category, expenses for the Patient Information System. Although performed under contract in 1977 because staff was not available, the salary and fringe benefits of a staff computer programmer have been added. Also, under operating expenses the maintenance cost of the computer has been added.

Nursing Administration staff coordinates external emergency services and education as well as S-T patient care nursing staff. The salaries of persons whose functions were for external activities were subtracted from the actual costs. In 1977, the Social Services Department was understaffed and has subsequently been increased. The gap was made up from the hospital and other sources. The salary item reflects the additional professional staff member and compensation for part-time clergy.

The Medical Records function is carried out for MEIMS patients within the S-T center. While only one position was filled in 1977, the vacant position has subsequently been filled and is reflected in the costs.

Patients discharged from the S-T Center and not referred elsewhere are followed at least once as outpatients. There is no item in the budget for this facility. Currently patients are seen two sessions per week in a hospital clinic which is not used during that period and for which the hospital is not reimbursed. The salaries include 250 hours of nurse and resident physician time. The operating expenses include supplies, depreciation, housekeeping and billing for outpatient visits.

Measurement of Indirect Costs

Although autonomous, MIEM is physically a part of the University hospital and takes advantage of its proximity. For example, it has available the pathologist of the hospital's laboratory for its clinical lab. The Diagnostic Radiology Department provides back-up for the staff available at MIEMS. It also provides services such as accounting and patient billing. This intermingling of services and facilities has created a problem in isolating those costs which are attributable to MIEMS. The Medicare Cost Report data were used for assigning department overhead costs for ancillary services which are revenue generating using the ratio of MIEMS charges to total hospital charges generated in the department applied to the following operating costs of the department: Net Expenses for Cost Allocation, Depreciation, Maintenance, Operation of Plant, Housekeeping and Laundry and Linen Service, where applicable. These were considered to be expenses directly related to the service provided as distinguished from costs necessary to operate the department within the hospital complex. For example, administrative personnel within the department are included in "Net Expenses". However, the allocation of hospital administration and general costs was omitted to avoid obvious double counting.

The hospital operating room is used as back-up only if the MIEMS operating rooms are occupied.

Indirect Costs

General Service Cost Centers

Operation of Plant, Maintenance and Utilities	$ 100,072
Laundry and Linen	141,581
Housekeeping	155,674
Dietary	141,781
Cafeteria	14,590
Pharmacy	23,841
Central Service and Supply	120,868
Patient Accounting **	55,000
Medical Records **	10,500
	$ 763,907

Ancillary Service Cost Centers

Operating Room	28,842
Diagnostic Radiology	244,803
Laboratory	253,145
IV Therapy and Solutions	608,652
Blood Bank	134,542
Blood	249,860
Physical Therapy	86,415
Electroencephalography & Electrocardiology	18,201
Renal Dialysis	18,889
Medical Supplies Charged to Patients	59,325
Drugs Charged to Patients	165,045
	$ 1,867,719
Total	$ 2,631,626

** Imputed

FIGURE 59: SHOCK-TRAUMA CENTER - Indirect Costs

Diagnostic Radiology provides all x-ray services for MIEMS. It bills and receives revenues for these services and in turn incurs all the expenses. The allocation is based on the RCCAC formula. One x-ray technician is on duty twenty-four hours a day, seven days a week in the MIEMS diagnostic operating room-admitting area. There are two portable x-ray units available. MIEMS supports a part-time radiologist who is available on site or on call to read x-rays. Frequently the medical staff reads the x-rays. If MIEMS supported its own Diagnostic Radiology Department the capital expenditures would be increased by the cost of the two portable x-ray units. Assuming the same staffing pattern it would cost approximately $55,000 for the technicians. The support of the part-time radiologist is already included in the MIEMS expenses. Assuming additional costs for support staff and operating expenses the total cost of operating a Diagnostic Radiology Department within MIEMS is likely to be less than the $244,803 allocated.

Although maintaining its own Clinical Laboratory, MIEMS does depend on the hospital laboratory for additional tests. The ratio of charges to charges is based on only those labs which MIEMS utilized. The laboratory cost included in the Cost Report however includes all hospital laboratories and therefore, is overstated. (The Medicare Cost Report includes the MIEMS Lab under laboratories. Since these are counted as direct costs for this analysis they were subtracted from the MCR lab total before applying the ratio.)

The Operation of Plant, Maintenance and Utilities includes the S-T Center allocation of hospital operating costs plus the actual cost of utilities incurred by MIEMS in fiscal 1977. On the MIEMS budget utilities are considered a direct cost. For consistency of analysis, the item was included in Operation of Plant. Laundry and Linen are allocated according to pounds utilized on the MCR. Housekeeping costs are allocated according to square feet. However, since the requirements of the S-T environment are different from routine housekeeping this service is provided under contract and while square feet are used to determine the cost, the rate charged per square foot reflects the stricter requirements.

Patient Accounting and Medical Records are both imputed. The allocation made on the MCR reflects the higher charges for MIEMS patients rather than actual cost in preparing the bill with respect to Patient Accounting. Based on 1,023 patients, the amount of $55,000 was estimated to process and prepare bills. This amounts to about $54 per patient bill and supports a staff of one supervisor and three clerks. The hospital allocation of $136,000 or approximately $133 per bill appears excessive and is due to the allocation basis.

MIEMS maintains its own Medical Records while the patient is resident. The hospital completes and stores the record. The direct costs of maintaining medical records was increased to reflect this condition and therefore the indirect cost for storing and completing the records in the hospital medical records library was imputed to cover .5 FTE medical records clerk and support services.

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